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ANNALS

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I.

MORPHOLOGY AND EMBRYOLOGY OF THE NASAL FOSSAE OF VERTEBRATES.*

By Leon Dieulafe,

IN CHARGE OF THE COURSE AT THE UNIVERSITY OF CLERMONT.

Translated by Hanau W. Loeb,

ST. LOUIS.

INTRODUCTION.

The nasal fossæ are hollow cavities in the facial bones, of varying importance, depending upon whether the animal is water-breathing or air-breathing; in the first group they serve exclusively as organs of olfaction, in the second they constitute, in addition, special canals through which the inspired air passes in order to reach the pharynx and the bronchial tubes.

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*This translation is made with the approval of Professor Dieulafé, and with the kind consent of M. Felix Alcan, publisher of the Journal de l'Anatomie et de la Physiologie Normales et Pathologiques de l'Homme et des Animaux. The translator feels that the high merit of Prof. Dieulafé's monograph and the absence of a similar work in English justify the effort here made to extend its sphere of usefulness.

The nasal organ is constant in all species of vertebrates; single in Amphioxus and cyclostomes, double in all other classes. Its development is in proportion to the acuteness of the sense of smell in the lower, water-breathing vetebrates; it is independent of this in air-breathing vertebrates, and in them it is very complex and greatly extended by reason of the influence of the respiratory area. The Amphibia constitute an intermediate form between these two groups, which is of great interest.

The necessity for active respiratory combustion entails a greater amplitude of the nasal fossæ in warm-blooded animals, while their extension is proportionately less in cold-blooded animals. A single anatomic characteristic is sufficient to show this difference: the posterior nares of amphibians and reptiles open into the buccal cavity, but into the pharyngeal cavity in birds and mammals. In the latter, the air passes more directly into the respiratory tract and its renewal is therefore easier of accomplishment. In measure as we advance in the scale of vertebrates, we may observe complexities of structure designed to purify and to warm the air (promoted by the ciliated mucosa and the rich vascularity). Two factors are responsible for this action, the turbinates and the sinuses. The venous plexuses produce the great vascularity. In the course of these transformations, the olfactory region is more deeply placed, where it is protected against the grosser impressions and reserved for the more specific.

Olfaction is the perception of odorous particles carried by the atmosphere which surrounds us, these particles being held in suspension in the air which comes in contact with the olfactory surface. The sense of olfaction, such as we know it, conveys to our minds an idea of the penetration of gas or vapor; but a mechanical action, a current of air, is necessary in order to bring it in contact with the nasal mucosa. Bernstein remarks that olfaction is the sense which has the greatest acuity. Toulouse and Vaschide (1899) measured the olfactory power with camphor water, testing their subjects with a series of solutions of 1 to 10,000, 1 to 100,000, and 1 to 10,000,000. The subject's eyes were bandaged and the solutions were presented to him successively, beginning with the weakest. The writers determined that olfaction was more acute in women than in men, and in girls than in boys. They also made a study of olfactory fatigue and demonstrated the great resistance of this sense, which was explained mainly by the simplicity of the perceptive apparatus.

The transportation of odorous particles by a gaseous medium is so necessary to our olfactory function, that it is difficult to recognize it in a liquid medium, which accounts for the doubts entertained as to the olfaction of fish. In man it seems probable that olfaction in a liquid medium is impossible. Weber demonstrated this in the following fashion: He filled his nose completely with cologne water (this experiment may be repeated without danger by lying in a horizontal position and allowing the head to hang downward vertically; the palate is thus raised, and water introduced into the nose cannot escape); as long as the water remained in the nasal cavity Weber could not perceive any odor, although he observed it perfectly at the time of the introduction of the water.

In aquatic animals, however, olfactory sensation may be of a different character, otherwise we should be compelled to deny the possibility of olfaction in fish. They have, at the disposal of this sense, a special apparatus, varying in its complexity with the different species, according as the corresponding nervous system (olfactory nerve and lobe) is developed. Geoffroy Saint-Hilaire speaks of the olfactory branchiae, and we may foresee in this single term the explanation which this author gives: The olfactory branchiæ, like the respiratory branchiæ, extract the air from the water and this air disengages the odorous particles dissolved in it. Carus, on the contrary, does not accord to fish any great olfactory power. The strongest gas, such as ammonia or chlorin, makes no impression on the olfaction of fish, while frogs are greatly affected by this same gas. According to this writer, the sense which guides fish towards prey should be called scent. Bernstein compares the olfaction of aquatic animals to the phenomena of gustation. Blaue bases this same opinion upon his histologic researches, and demonstrates olfactory buds analogous to taste buds in a large number of fish. Duméril bases his opinion on the testimony of sailors and upon the results given in fishing with certain kinds of bait, and reports the arguments made by Cloquet to show the olfactory sense of fish: "Sailors state that when the blacks and whites bathe together in places frequented by sharks, the blacks, whose odorous emanations are more powerful than those of the whites, are more exposed than the whites to the attacks of these terrors of the seas."

Lacépede admits a most delicate olfactory susceptibility in fish.

It is, above all, in air-breathing animals that we find the olfactory sense least developed (birds, dolphins). The ancients were unanimous in claiming that birds had a very remarkable acuity and certainty of olfaction. They even cited the fable of the crows and vultures flying from Africa and Asia to Europe after the battle of Pharsalia. In modern times it is claimed, on the contrary, that birds are poorly endowed with this power. Buffon and Cuvier report that hawks seize upon their prey when it is struck and before it exhales any odor, while a few leaves thrown over it are sufficient to protect it from their attack. Milne Edwards has made some experiments in the Museum of Natural History. He placed, in a cage of vultures, a box covered by a curtain. This was torn at different times, until the birds became accustomed to the object and paid no attention to it. He then introduced into this box, covered in this simple way, some food with a strong nauseous odor, without the birds noticing it. When they were deprived of their customary nourishment they were bewildered, but made no attempt to attack the box. It is sight that plays the chief role in all birds of prey.

Toussenel (1873) says that the birds have no smell, just as they have no taste. It is not necessary, in animals which are to eat many things and to like everything they eat, that there should be a watchful sentinel before the stomach which would bring difficulty in the way of acquiring nourishment.

Raspail (1899) made, very recently, a series of observations concerning the sense of olfaction in birds. He noticed pheasants, partridges and wood pigeons leaving their usual bait when the wind carried towards them odorous effluvia betraying a concealed enemy. These birds discovered, by means of olfaction, an invisible vessel of water, the situation of which was often changed. The odor of a piece of Swiss cheese makes it possible to capture a titmouse. The titmouse, the crow and the magpie descend from great heights in search of worms buried in the ground.

The opinions of observers differ, but none is of any absolute value. In reality, the olfactory power of birds exists, but it is very feeble.

In cetaceans, the nasal fossæ are without any olfactory region and moreover the olfactory nerve is very much reduced or absent. However, Cuvier has observed an organ of olfaction in the dolphin and in the porpoise. Whales have olfactory sensations. In fact, Lacépede reports that Pleville le Peley has seen whales leave a boat which contained decaying codfish. The property of secreting spermaceti has been attributed to these nasal fossae without sensorial role, or to the sinuses. Pouchet and Beauregard have observed that, in the cachelot, this substance is deposited in the recesses independent of the nasal cavities and their adnexa.

Besides these animals with a more rudimentary olfactory sense, mammals present varying degrees of olfactory power. They are divided into osmatics and anosmatics, depending upon the acuity of this faculty.

Distinct anatomic differences do not exist between these groups, carnivorous animals (macrosmatic) and the ruminants (microsmatic); there exists, however, some variation in structure.

The olfactory region occupies a greater or less extent of the nasal cavity and its relation to the respiratory region is very variable. My aim is to establish the respective value of the nasal organ upon anatomic and embryologic observations, and it is only by a study made upon the entire series of vertebrates that we can arrive at conclusive results. The anatomic literature abounds in works relative to the nasal fossae and this has furnished me numerous references.

In my study I have been occupied only with the nasal cavity and its adnexa, leaving out entirely the description of the corresponding nervous system. I have divided this into three chapters: I, Morphology, II, Embryology, III, General Considerations. In the final résumé, I report only the facts which have a value from the standpoint of comparative study.

I have carried on the greater part of my investigations in the Laboratory of Zoology of the Faculty of Science at Toulouse, where I have found extensive material for study.

In so far as embryology is concerned, I have been enabled to make numerous observations upon the rich and priceless collection in the laboratory of histology of the Faculty of Medicine at Toulouse. In the course of my work I have received numerous favors from Profs. Charpy, Moquin-Tandon, Tourneux and Dr. Jammes, Head of the Conference of Zoology, and Dr. Soulie, Professor Agrégé of Anatomy. I thank them for their advice and for their invaluable suggestions, for their generous hospitality, and I assure them of my gratitude and devotion.

Prof. Giard, Member of the Institute, has had the kindness to furnish me with suggestions and I express to him my deepest gratitude.

My friend, Dr. Mandoul, Preparateur of Zoology, has facilitated my task by procuring for me a large amount of material; I thank him sincerely.

I am very grateful to Messieurs Roques and Durand and to Dr. Soule for kindnesses which they have shown in the execution of the figures which accompany the text.

MATERIALS FOR STUDY.

For the anatomic portion, I have had recourse to dissections and microscopic sections imbedded in paraffin. I have followed, several times, the procedure of Retterer (1903) (imbedding in vacuum at 40 degrees). For embryologic study I have used serial sections after fixation in Kleinenberg's fluid.

The adult specimens were decalcified by the procedure of Morel and Soulié (formic acid 1-5), stained en masse with alum carmine.

My studies have been carried on with the following animals:

I. MORPHOLOGY—*Cyclostomes:* Petromyzon, Ammocetes. *Selachians:* Scyllium, Acanthias, Raja. *Teleosts:* Barbel, Gurnard, Trout, Eel, Cod. *Ganoids:* Sturgeon. *Amphibians:* Toad, Frog, Triton, Axolotl. *Reptiles:* Adder, Viper, Blindworm, Python, Boa, Galeote, Crocodile. *Birds:* Pigeon, Duck, Turkey, Vulture. *Mammals:* Complete series of bone specimens; Guinea Pig, Mouse, Rat, Badger, Sheep, Cat, Dog, Monkey, Man.

II. EMBRYOLOGY—*Cyclostomes:* Petromyzon planeri of 4 and 6 mm. *Selachians:* Pristiurus melanostomus of 3 to 22 mm. and Scyllium canicula, 30 millimeters. *Teleosts:* Salmon Trout 22nd day of development and 30 days after hatching, and Rainbow Trout, 30 and 60 days after hatching. *Amphibians:* Toad and Frog, larva of 4 mm. *Reptiles:* Adder of 4 cm., Blindworm, 25 mm. to 7 cm., Viper 4 cm. *Birds:* Undulated Parrot of 5 to 23 mm., Duck 4th to 12th day of incubation. *Mammals:* Guinea pig 5 to 14 mm., Sheep 8 to 25 mm., Mole 4 to 17 mm., Human Embryos 8 to 16 mm., 23.5 cm. The first stages of the undulated parrot and of the sheep, the complete series of the mole and human embryos have been studied in Prof. Tourneux' collection.)

CHAPTER I.

MORPHOLOGY.

AMPHIOXUS.

Koelliker described, in 1843, the olfactory organ of Amphioxus. This very rudimentary organ is formed by a single involution which is attached to the nervous system by its sharp inferior extremity.

This shallow, cupuliform depression is situated on the left side of the head, in front of the left eye, and is separated from it by the most anterior nerve trunk.

This organ is not united to the buccal cavity. It consists of an external cartilaginous envelope and a mucosa with a ciliated epithelium. The presence of cilia is the most characteristic sign that causes us to think that the fossa is really the olfactory organ.

De Quatrefages (1845) described the same fossa with all the characteristics noted by Koelliker.

Paul Langerhans (1876) found in the epithelium, which lined the fossa, two kinds of cells, one tall, narrow and cylindrical, each one provided with a long cilium. The others also have cilia, but are distinguished from the first by the smallness of their bodies and the largeness of their nuclei. These elements are easily separable into small groups and may be regarded as true olfactory cells, and their cilia as sensory cilia.

FISH.

I. CYCLOSTOMES.

The cyclostomes belong to the Monorrhina. They have a single olfactory organ placed in the median line, which opens on the dorsal surface of the head.

ORIFICE.—The orifice is round, narrow, usually terminating in a small tube which projects 1 to 2 mm. above the integument. Its situation corresponds to the blow-hole of the dolphins, so one must admit that there exist Monorrhina among the Mammalia. But here the Monorrhina is characterized not only by a single nasal opening, but also by a single nasal sac.

Vogt and Yung (1894) described, in these folds, a fibrous thickening of the subcutaneous tissue, and in the interior of the tube, close to where the entrance opens into the sac, a very peculiar valvular apparatus analogous to those of the cardiac arteries. This tube, or more correctly the folds that enclose it, is detached from the rest of the integument at the bottom of a depression, in such a way that the tube projects above the dorsal surface less than its entire height, and is surrounded by a circular, uninterrupted groove. While in Petromyzon, the tube is narrower at its extremity than at its base, in Ammocoetes it widens exteriorly into a funnel.

It extends from above downwards and from before backwards, and leads into the nasal sac, its base being lost in the walls of the latter.

Nasal Cavity.—The dimensions of the nasal cavity are not great. It is situated at a considerable distance behind the tip of the snout, immediately in front of the brain, above the digestive tube, from which it is separated by a very thick mass of muscle in Ammocoetes, while in Petromyzon there is only a cartilaginous septum between the two organs. Its position is well shown by a sagittal section of Petromyzon (Fig. 1).

The interior of the nasal cavity is occupied by lamellae which cause folds of the mucosa. In Petromyzon, the lamellae are arranged around all the walls in such a way that they converge towards the center. They are thick and very slightly elevated. Langerhans, Vogt and Yung observed a median, vertical lamella which divided the cavity into two symmetrical halves, and these correspond to the nasal fossae of more highly organized animals. We have never found anything similar in Petromyzon, and Pogojeff never observed any trace of this relation. It was different, however, in Ammocoetes. In a transverse section passing through the middle of the nasal cavity (Fig. 2), a long thick lamella can be seen running vertically downward from the dorsal wall nearly to the floor, and in the exact median line.

On each side is found a fold of the ventral wall forming an ascending lamella which is almost vertical and concave on its internal aspect.

Between the lamellae, in Petromyzon, is a star-shaped cavity, of considerable size in comparison with the nasal sac. In Ammocoetes, there are only stellate fissures.

An axis of connective tissue extends into the interior of each lamella. This is condensed at the periphery and forms a layer separating the mucosa from the cartilaginous sac. In the connective tissue, in Petromyzon, there are numerous pigment cells, which give a dark color to the nasal organ.

Capsule.—The cartilaginous capsule completely surrounds the olfactory apparatus. It is open at its anterior pole to communicate with the entrance tube. Behind, it is perforated to give passage to the olfactory nerves. Furthermore it is in relation with the naso-palatine tube, a kind of diverticulum from the ventral wall, which is directed downwards towards the digestive tube but does not reach it. As our sagittal section (Fig. 1) shows, this canal arises at the anterior part of the nasal sac, and runs obliquely backwards and downwards, and ends in a large cul-de-sac, which lies below the cranial cartilaginous capsule and above the digestive tube. Its posterior wall is in relation with the branchial laminae. In Myxine, the writers describe the communication of this canal with the buccal cavity, which brings the cyclostomes close to the vertebrates in aerial respiration, and this finding is favorable to the hypothesis that the cyclostomes are vertebrates that have degenerated under the influence of a parasitic life.

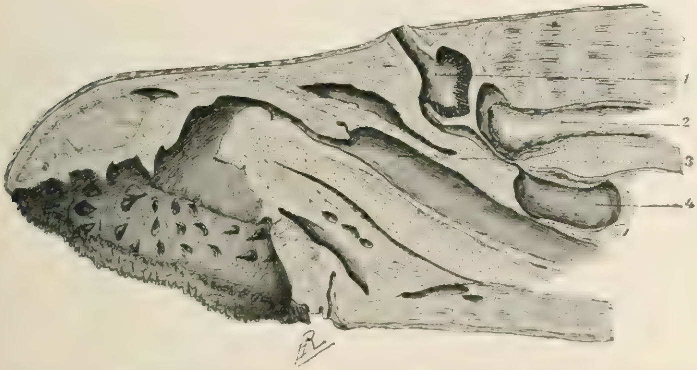

Fig. 1. Half natural size. Petromyzon planeri (Sagittal section). 1. Nasal cavity; 2. Central nervous system; 3. Digestive tube; 4. Naso-palatine canal terminating in an ampullar cul-de-sac.

The extent of the cartilaginous capsule can be easily seen in sections or upon dissection.

While completely isolated in Ammocoetes and separated from the neighboring organs by connective or muscular tissue, in Petromyzon it is in intimate relationship with the cranial capsule and fuses with its anterior wall; at this level a simple partition separates the olfactory organs from the brain. The filaments of the olfactory nerve are very short as the result of the topographic relations of these two organs. In the interesting horizontal sections of the nasal cavity and nervous system, two series of olfactory filaments (Fig. 3) are to be seen, between these two structures. They arise from the anterior wall of the brain, on each side, from the interhemispheric fissure and meet at the bottom of the nasal cavity; the different branches are distributed to the two symmetrical regions, posteriorly convex, which are placed on either side of a median lamella. On the ventral side, a layer of connective tissue

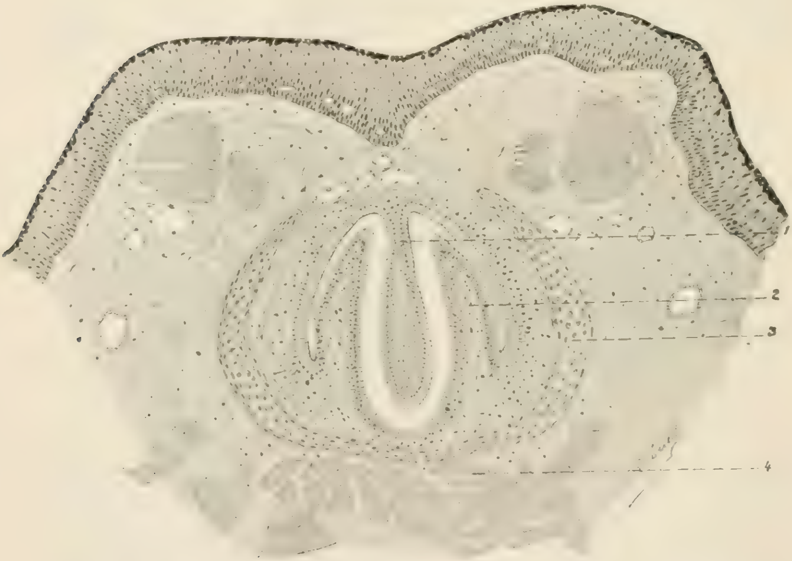

Fig. 2—X 70. Ammocoetes (transverse section passing through the nasal cavity). 1. Median dorsal lamella; 2. Ventral lamella; 3. Cartilaginous capsule; 4. Muscular portion.

separates the capsule from the cartilaginous roof of the digestive tube.

Glands.—The olfactory apparatus of the cyclostomes is distinguished from that of other animals with aquatic respiration by the presence of glands. They are situated, according to Pogojeff (1888), Vogt and Yung, at the bottom of the organ, in the segment which is limited to the olfactory bulb; they penetrate into the cartilaginous tissue and are surrounded by nerve fibres. The cellular elements of these glands described by Pojogeff are formed of two kinds of goblet cells; one is very long, very contracted and provided at its lower extremity with a long, very thick prolongation; towards the superior extremity there is a striated area, while the nucleus lies in the middle of the cell. The other cells are larger with a round base containing the nucleus. We have not found this glandular apparatus in Ammocoetes.

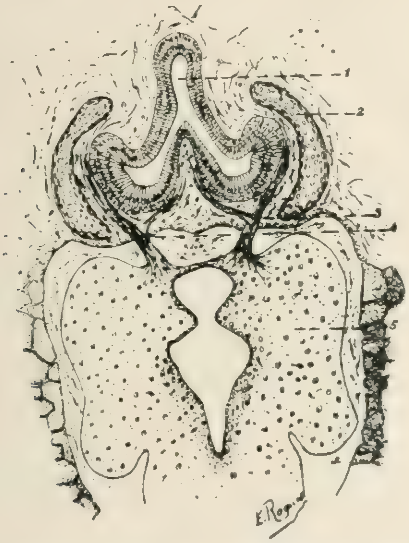

Fig. 3—X 70. Ammocoetes (transverse section showing the nasal cavity and two olfactory nerves). 1. Nasal cavity; 2. Cartilaginous capsule; 3 and 4. Olfactory nerves; 5. Brain.

Scott found in a larva of Petromyzon, 12½ mm. long, in the posterior part of the nasal cavity, a diverticulum whose place in the adult is taken by the gland we have just described.

He considers this formation to represent the organ of Jacobson, in which opinion Bujour concurs.

There can be no question of such an organ in these animals. The independence of the nasal apparatus and the buccal cavity is sufficient to explain its uselessness and its existence only adds to the regressive characters which connect the cyclostomes with air-breathing vertebrates.

MUCOSA.—Retzius (1880), in Myxine, found a cylindrical epithelium without nervous terminations at the free, anterior border of the folds and at the posterior fixed border, as well as in the furrows between them. On the surfaces of the folds, turned towards each other, the epithelium which is, on the contrary, much taller, is the olfactory epithelium.

In Petromyzon, a similar distribution is found in the topography of the nasal epithelium. The true olfactory epithelium shows two fundamental cellular forms. The first consists of long processes which extend the entire height of the olfactory epithelium, in the middle third of which the nucleus is found. The protoplasm is entirely clear with hardly a granule. The superior extremity is covered with a finely granular border from which delicate, wavy cilia extend. The inferior extremity of the cells is very often enlarged. In the other cellular form, the body is shorter, pea-shaped and the nucleus is very much higher. The superior extremity is thin and the inferior extremity does not reach the deepest layer of epithelial cells, and encloses the nucleus. The substance is clear, but distinctly granular. The delicate inferior prolongation extends to the connective tissue, but Retzius was not able to find its communication with the nerve fibres.

Pogojeff (1888) found in Petromyzon a flattened epithelium at the edge of the free border of the folds, as well as in the depressions which limited them. These cells are large and slightly elevated and are provided with cilia.

Upon the lateral surfaces two series of cells are found, which are made manifest by two series of nuclei placed at different heights. Some are cylindrical, in the form of goblet cells; others are conical, with an enlarged superior extremity and an inferior extremity pointed and bent inward. These are the supporting cells. The second variety of cells merits the name of neuro-epithelium. They are round and fusiform, terminating inferiorly in a varicose prolongation, and their superior extremity forms a sort of cap. Furthermore, they are as small as the first, are almost cylindrical and are narrowed towards the extremity, from which a nerve prolongation arises.

In Ammocoetes, we have found in the whole extent of the nasal cavity, as well as in their intervening folds, delicate, greatly elongated, cylindrical cells, which present a clear and homogenous central portion and a peripheral portion containing the nucleus and highly colored protoplasm. Between the peripheral prolongations of the cells, there are found irregular elements, some rounded and some slightly elongated. The epithelium upon the dorsal lamella measures 36 mikra in thickness; upon the ventral lamella, 26. The cells throughout the mucosa have an average height of 14 mikra (Fig. 2).

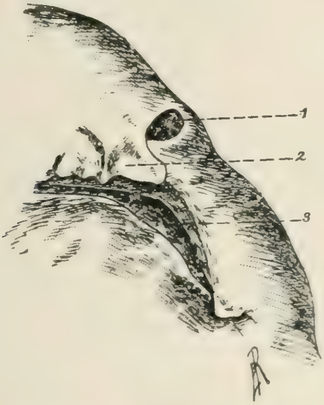

Fig. 4. Half natural size.—Scyllium catulus (ventral surface of the head, showing the valve of the anterior border of the nasal orifice). 1. External part of nasal orifice; 2. Valve of the anterior border; 3. Buccal orifice.

II. SELACHIANS.

We will commence the series of Amphirhina with the selachians; they are distinguished from the other animals of this large group by the ventral position of the nasal orifices.

ORIFICE.—For each nasal cavity there is only one orifice. In Scyllium catulus the nasal cavities are very far from one another. This peculiarity distinguishes it from Scyllium canicula, where they are contiguous in the median line. Each nasal orifice or naris is a very wide, transverse cleft placed in front of the buccal orifice. A large, high valve, a prolongation of the anterior or superior border, covers the greater portion of this slit (Fig. 4), only the external region being free; it has the form of a circular opening. This region is accessible to the current only from the front. On lifting the valve, the entire extent of the opening is visible, but it is divided into two regions by a tubular prolongation, which extends forward from the posterior or inferior border.

On examining the naris from its internal instead of its external face, after the nasal cavity has been opened wide, it is seen that the prolongation from the posterior border represents a kind of a valve which masks the external part of the orifice (Fig. 5). Seen from this side, the latter is freely opened in its inner two-thirds and has the form of a funnel. This internal part of the orifice favors the exit of the current of water.

To sum up, two incomplete valves are opposed to one another. The portion of the orifice which is not covered by the anterior valve is open outward. This is the orifice of entrance. The part which the posterior valve leaves free has a wide opening internally which is the orifice of exit. This valvular apparatus forms a double orifice, from a functional standpoint.

In Raja batis, the anterior valve is arranged as in Scyllium, while the posterior valve does not exist.

Lacépede (1867) ascribes to these animals the power of completely closing their nasal orifices by means of the valve, and of being able to close the olfactory apparatus, under certain circumstances, to useless or very intense sensations. He compares this valve to an eyelid.

Cavity.—The cavity has an almost elliptical form and is occupied by lamellae arranged in two long rows with a transverse axis, and inserted in the roof of the nose in such a way that they run vertically downward. The inferior border is free, the external border is bound to the wall by a little, delicate, non-resistant tract. Their height is from 18 to 20 mm. and their transverse extent from 5 to 6 mm.

The nasal cavity is bounded by a connective tissue partition which contains numerous pigment cells. Surrounding it is a cartilaginous capsule analogous to those which surround the eye, ear and brain.

This very simple capsule moulds itself around the nasal sac. Behind, it is in relation with the olfactory bulb, the filaments of which penetrate it in order to enter the nasal sac.

Within the cavity, the mucosa presents numerous folds inserted at the level of the roof and lateral walls; the highest are situated at the middle of the dorsal wall. They are composed of a connective tissue axis containing blood vessels, covered with an epithelium which is uniform in structure and formed of cylindrical cells.

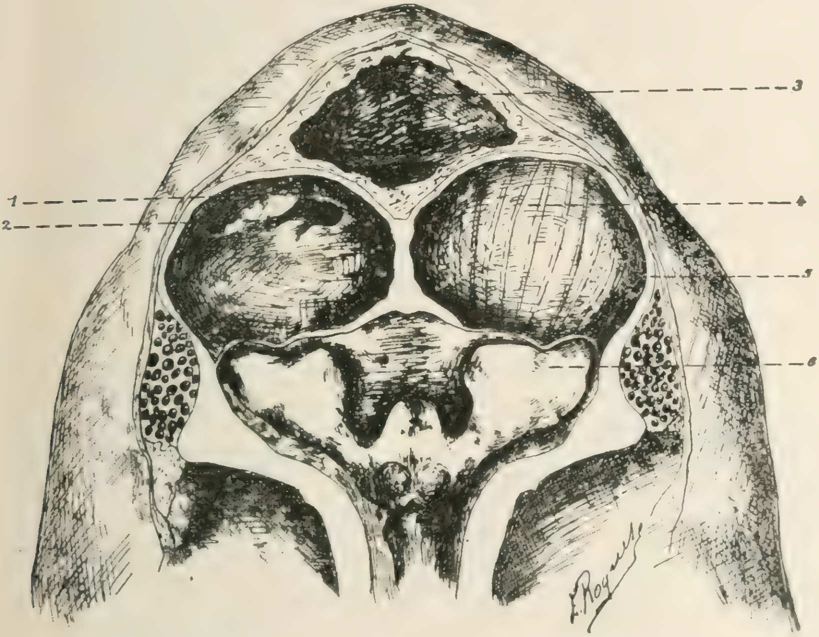

Fig. 5. Five-eighths natural size. Scyllium catulus (both nasal cavities and the cranial cavity are opened on their dorsal surface. On the right, the olfactory sac; on the left, nasal cavity with contents, showing on the floor the internal part of the nasal orifice and the valve inserted on the posterior border of that orifice). 1. Valve of the posterior border; 2. Internal portion of the nasal orifice; 3. Cavity containing mucous tissue; 4. Olfactory sac; 5. Cartilaginous capsule; 6. Olfactory bulb.

Blaue (1884) did not find among the plagiostomes the olfactory buds which he describes in a large number of teleosts. As Leydig and Max Schultze have already shown, there is no particular region for the olfactory epithelium; it is spread out over the folds of the mucosa, but does not reach their free border and is especially abundant in the intermediate grooves.

The olfactory epithelium, according to Max Schultze, covers bands which reveal themselves in the mucous folds; it consists of ciliated cylindrical cells which have a long basal prolongation, of fusiform olfactory cells with a basal segment containing the nucleus and provided with two prolongations, and of replacing cells which are attached to the underlying tissue by a series of fine denticulations. Between the flattened feet of these cells lie stellate connective tissue cells, which form the most superficial layer of the membrana propria.

Koelliker assigned a nervous function to this epithelial layer, but Max Schultze does not agree with this; he finds that the finer branches of the olfactory nerve enter into the epithelium.

III. Teleosts.

These form the second group of Amphirhina. Their nasal apparatus shows certain common, primordial characters, with considerable variation in detail. The latter are mentioned in works dealing with their classification.

Orifices.—The nasal cavity is entered by one orifice, or by two orifices both of which open externally. An exception is described by Wiedersheim (1890) among the Dipnoa (Protopterus) where there are two nasal orifices, one situated near the upper lip, the other much further back. The nasal organ has no direct communication exteriorly, but opens into the buccal cavity. In other fishes, the orifices show certain differences in form and position. The anterior orifice is sometimes pierced at the level of the skin by a posterior lip prolonged as a tentacle (Gadus, Mustelus), and sometimes it reaches the extremity by a tubular prolongation (conger, gurnard and eel).

The posterior orifice always opens on the surface of the skin, is usually elliptical, but in the gurnard it is a simple slit. It is joined to the anterior orifice in the barbel; it might be said that a single orifice is converted into two by an anteroposterior bridge. The anterior orifice, which at the same time is the internal, has a sort of valve covering it formed by simple prolongations of its internal border. This valve prevents the entrance of water into the nasal cavity but allows its exit. The tube or tentacle, which is found in a large number of species, is said to play the same role. The posterior orifice is used for the entrance and the anterior orifice for the exit of the current.

Cavity.—The nasal cavity is a very simple sac. If the dorsal wall in the barbel or the gurnard is lifted, a large number of folds will be found extending into the cavity and in a measure occupying it. These folds resemble rays disposed around a central lumen. They are inserted at the bottom and periphery of the nasal sac, and all have the same dimensions. Between their free borders, the nasal lumen has the form of a cup, and from its center it radiates between their surfaces.

The olfactory nerve enters the nasal sac from below, about the middle, and from there it is distributed to the lamellae.

In the eel, there is a different disposition of the lamellae; they are placed on each side of a longitudinal axis, parallel to each other, and are inserted into the floor of the cavity (Fig. 6). They have a quadrangular form, narrow in front, prolonged into a cylindrical tentacle towards the anterior orifice, and extend beyond the end of the nose. The large, round, posterior extremity shows the posterior orifice at its external angle.

A transverse section of the head of the eel (Fig. 6) shows the insertion of the lamellae along the floor, and the contour of the nasal sac, formed by a connective tissue sheath. This is usually pigmented, black or brown, which makes the nasal sac easy of recognition in dissection. As they are placed near the dorsal aspect, the nasal organs are completely independent of the buccal cavity, from which they are separated by a bony wall. A vertical bony septum separates them from each other in the median line. The bones are never in direct contact with the nasal sac, being separated from it by a considerable amount of connective tissue.

Skeleton.—The skeleton is formed by a series of facial bones which are arranged not so as to define a bony nasal cavity, but to form an irregular interspace in which the fibrous nasal sac is situated without any adaptation of form. We have studied this nasal skeleton in the cod, where there is a superior wall formed by the middle ethmoid and the nasal bone, an external wall formed by the anterior frontal, and an inferior wall formed by the vomer and the lateral ethmoid (Fig. 7).

Nasal Bone.—A paired, flattened bone, larger behind than in front, with rectilinear internal and external borders. The posterior extremity shows a groove. Longitudinal undulations of the superior surface form a projection along each border with a groove in the middle. The inferior surface is concave in its external portion, projecting in its internal. It is articulated in front with the maxillary bone and, external to this extremity, with the anterior frontal; behind with the frontal, internally (posterior third) with the median ethmoid.

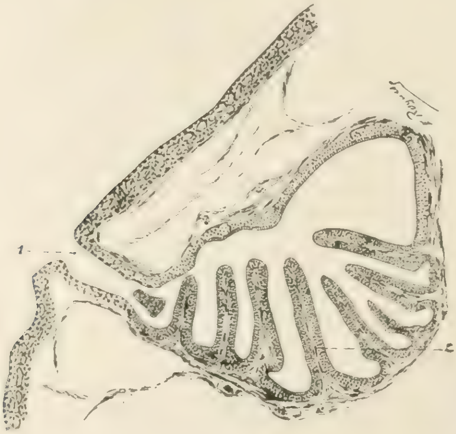

Fig. 6—X 40. Eel (transverse section of the nasal cavity passing through the posterior orifice). 1. Posterior nasal orifice; 2. Lamellae.

Frontal Bone.—Single bone, large, squamous, bifid anteriorly, each half corresponding to one nasal bone. It is only by this anterior extremity that this bone enters into the formation of the nasal skeleton. At the angle formed by these two points, it articulates with the middle ethmoid and, by lamellae derived from its inferior surface, with the lateral ethmoids.

The Middle Ethmoid.—Single bone, presenting a large anterior part and a thin, tapering posterior part. The anterior part is thick and curved at a right angle, so as to present a horizontal and a vertical segment. Some lamellae derived from the borders of this bone are directed backwards and outwards, forming together an inverted funnel. The middle part of this bone is prolonged backward to form a posterior part which tapers out, articulating with the lamellae of the frontal bone. The anterior part is united along the median line with the vomer and laterally with the lateral ethmoids.

Lateral Ethmoid.—Paired bone, irregular, with a very thick massive body from which wing-like lamellar prolongations extend on all sides.

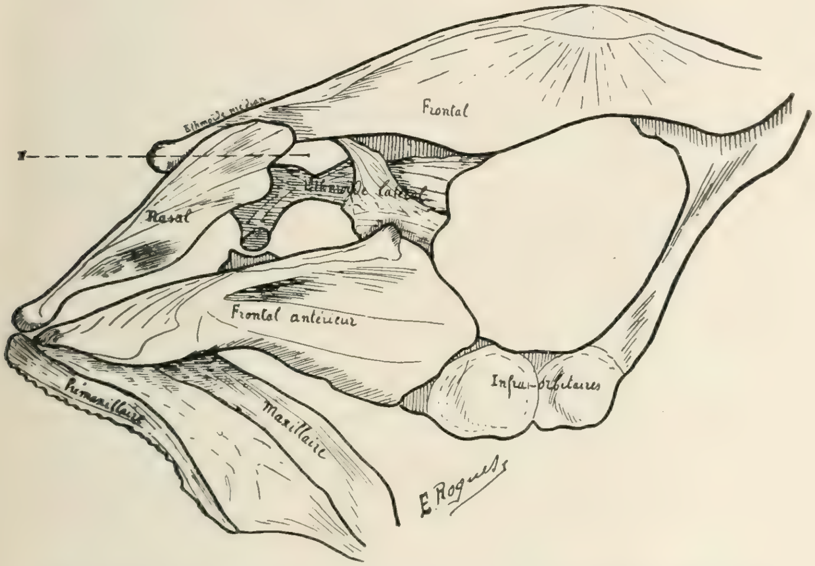

Fig. 7. Half natural size. Cod (external view of the head showing the bone surrounding the nasal region). 1. Space for the nasal sac.

Anterior Frontal or Prefrontal Bone.—This is a bone of large size, very long, flat, of triangular form, with its anterior apex joined to the premaxillary bone, with its posterior base united internally with the lateral ethmoid, and externally with the infraorbital. Its internal border is at some distance from the nasal and frontal. There exists between them a large interspace which in the fresh state is filled by a fibrous membrane. This membrane is pierced by the orifices of the nasal sac.

Vomer.—Single bone with an anterior enlarged portion which zoologists call chevron (Moreau) and a long posterior prolongation. The inferior face of the vomer, in the place corresponding to the edge of the chevron, is provided with teeth; behind it is smooth. The vomer is united in front with the two maxillary bones, with the palatal bones by the projections of the chevron; above with the ethmoids; below it is free and forms part of the palatal vault.

The names given above are taken from the nomenclature of Cuvier and Agassiz.

The osseous part of the cranium is subject to variations of one kind or another, and we were not able to make a detailed study. Sagemehl (1885) made an extended study of the crania in the Characinidae. His nomenclature is very similar to that which we have given for the cod. The prefrontal forms the posterior limit of the nasal region and contains two canals, which run from the orbit to the nasal fossa. The inferior orifice gives passage to the olfactory nerves and the superior to a branch of the trigeminus. The middle and inferior boundaries of the nasal apparatus are formed by a part of the primordial cranium which has remained cartilaginous; the inferior part of the septum is formed by the vomer which behind is united with the parasphenoid. The roof of the cavity is formed by the nasal bone. In the work of Swinnerton (1902) upon the development of the cranium of the teleosts, we find plates showing Gasterosteus aculeatus with the bones of the nasal region similar to those which we have described and designated.

NASAL SAC.—The connective tissue which surrounds the nasal cavities is condensed into a fibrous membrane and forms a complete envelope broken only at the level of the nasal orifices. This wall is delicate, of little resistance and contains a considerable deposit of pigment. The deep layers are formed by a looser connective tissue which deep down is directed toward the cavity and acts as a support for the lamellae of the mucosa. It contains vessels and nerves.

MUCOSA.—Schultze, Grimm, Blaue, Sophie Pereyaslawzeff and Dogiel have studied the structure of the olfactory mucosa. Two kinds of cells have been found; one epithelial (supporting cells), and the other neuroepithelial (olfactory cells). Dogiel (1887) described the supporting cells of the ganoids as very fine membranous formations which seem concave because they are adjusted to the convexity of the adjacent olfactory cells. Their staining reaction is similar to that of mucous cells. He found three kinds of elements among the olfactory cells: The first is the olfactory cell of Schultze, which is very delicate, with central extremity thickest and peripheral part appearing as a varicose prolongation in direct continuity with the primary fibril of the terminal roots of the olfactory nerve. The second has a cylindrical form, and the third is a thick structure in the form of a cone or cask.

The researches of Blaue (1884) were carried out upon a large number of species of fishes. He has found two kinds of animals. In some, the olfactory cells are grouped to form olfactory buds in every way analogous to the taste buds. These open upon the epithelial surface by pores which open into a small cup. The epithelial elements are long, extending from the basal connective tissue to the level of the tube. They are alternately supporting and sensory cells. Between the pores, the indifferent epithelium is composed of cells arranged in the form of overlapping cells. The most superficial are flattened; deeper down, they are polyhedral, cylindrical and, finally, fasciculated. The olfactory buds show a very variable distribution, sometimes spreading out over the entire lamella and the intermediate spaces (Belone), sometimes lying only in the intermediate spaces (Trigla gurnardus, Exocetus volitans, Umbra cameri, etc.). Sophie Pereyaslawzeff (1876) considers the olfactory bulbs to be groups of olfactory cells and does not mention supporting cells.

In another group of fishes (the eel, conger, the carp, tench, etc.) the olfactory epithelium is such as has been described by Leydig and Max Schultze. It extends over the entire lamella and generally, in the intermediate spaces, it is replaced by indifferent epithelium. Huot (1902) found in Lophobranchia, by the method of Golgi, that the olfactory cells were composed of a large, oval, basillar portion and a narrow prolongation, which extended toward the free surface of the epithelium. This prolongation slightly projects into the cavity and may be either simple or bifurcated.

In the eel and the trout, a homogenous epithelium extends over the lamellae and their interspaces. The cells are long, cylindrical, with a deep part containing a large oval nucleus and a superficial part containing clear, finely granular protoplasm.

The dorsal and lateral walls of the nasal cavity are clothed with a stratified epithelium. The deeper cells are rounded, the most superficial are elongated, but their height is irregular.

There are no traces of glands in the nasal mucosa.

Winther described in the salmon a canal which he considered the organ of Jacobson. It runs downward, is situated below the olfactory cavity and terminates in a cul-de-sac. According to Jungersen and Sagemehl, this is simply a mucous canal which extends transversely between the two nasal cavities during embryonic life, persisting through life in Amia. Wiedersheim admits the presence of an organ of Jacobson in Polypterus bichir, an opinion which is not shared by Waldschmidt (1887).

Garnault did not find the organ of Jacobson in the dipnoans, nor did Seydel in the teleosts. Even during embryologic developments, we have never found any diverticulum which could correspond to it.

IV. Ganoids.

The sturgeon has two nasal orifices placed just in front of the eyes, one at the internal border of the dorsal aspect of the head and the other on the external. The first, which is the most internal and anterior, is circular. Its borders are rigid and distinct.

The other, which is external and posterior, has an elliptical form with a large vertical axis. Its borders are gradually lost in the neighboring parts. On the anterior border, a movable membrane is placed, which covers a large part of the orifice like a valve. This valve is to close the opening under the influence of an external force, and seems to prevent the entrance of water through the postero-internal opening, while permitting its exit. The antero-internal orifice has a large opening, is accessible to the exterior current and serves for a port of entry.

Between these two orifices is a cartilaginous bridge covered with a dermo-osseous plate running from above downward and from behind forward; it is very narrow (5 mm. in a specimen of 1 metre total length). The valve of the posterior orifice seems to enlarge it.

The walls of the nasal cavity are composed of thick, resistent cartilage; furthermore, the external, dorsal and internal walls are covered with a bony sheath.

After ablation of this bridge, lying between the two nasal cavities, a large recess gives entrance to the nasal cavity. This has the form of a semi-hemispherical capsule. In the center, there is a cylindrical axis from which runs numerous lamellae towards the borders of the cavity. These lamellae are largest near this axis, gradually decreasing as they approach the periphery.

We have not found the secondary lamellae noted by Moreau (1881). A long cartilaginous conduit placed within the orbital cavity extends obliquely from within outwards and from behind forward from the cranial cavity to the floor of the nasal capsule. It contains the olfactory nerve, a large cylindrical cord, which reaches, in this form, the axis of insertion of the lamellae and then divides into branches which are distributed throughout the whole organ.

The nasal cavity, as a whole, is situated in front of the eye, but in the same horizontal plane. It is very far in front of the cranial cavity, and separated from that of the opposite side by a distance of 2½ cm. It is situated on a vertical plane considerably anterior to the buccal orifice.

AMPHIBIA.

The nasal cavities begin to assume the aerial type; a portion of the air in passing through them reaches the pulmonary apparatus. From now on, they occupy a double role, olfactory and respiratory, but the latter is still of slight importance.

ORIFICES.—In taking as a type the frog (Rana esculenta) or the toad (Bufo vulgaris), which presents the same conditions, we find the nasal cavities provided with two openings, one external, the other internal. The external dorsal orifice is situated upon the side of a median antero-posterior projection, and extends from the biocular line to the end of the snout, penetrated at the junction of its anterior and middle thirds by this projection. It is circular and limited by well-marked, rigid borders. These form a slight cushion in the external part of the orifice which, according to certain authors [Vogt and Yung (1894) Chatin (1880)] constitutes a short tentacle which closes the nose when the frog plunges into the water. The border is bony only on its inner side; otherwise it is composed of integument alone. The muscular fibres below the skin have been studied in the frog, triton and salamander by numerous authors. Zenker, Duges, Klein, Ecker, Gaupp, Volkmann and Collan have described certain bundles, disposed around the external nasal orifice. Moreover, Henry Bruner (1902) published an extensive study of the mechanism of respiration in the Amphibia, with lengthy and minute descriptions of the nasal muscles. There is a dilator muscle and, in some species, one or two constrictor muscles..

The inner orifice, visible at the edge of the palatal vault, a short distance from the lip, is a little posterior to the external orifice. The air passing through the nasal cavity must go through a large part of the buccal cavity before reaching the respiratory passages. The nasal air passageway is still imperfect. The internal orifice is circular, wide open, surmounted within by a small round tubercle visible in the frog and absent in the toad. It is further from the median line than is the external orifice.

In the siren, Vaillant (1863) found that the internal orifice is quite anterior, in the gingivo-labial fold, at the level of the posterior part of the dental laminae. This is the result of the almost exclusively aquatic character of the animal.

Cavity.—The cavity, possessing these two kinds of orifices, is simple with almost smooth walls. Upon removal of the superior wall, the cavity may be seen, rectangular in form, measuring, in a frog of average size, 5 millimeters in its antero-posterior diameter and 7 mm. in its transverse. At the level of the floor, there are a groove within and an antero-posterior ridge externally. The posterior part of the ridge is especially well marked; external to it is found the internal orifice. Irregular folds of the mucosa are observed at the antero-internal angle of the cavity. At the level of the folds, the color of the mucosa is darker than that of the rest of the nasal cavity, while at the level of the posterior part of the groove it is a spotted dark brown. The cavity is flattened in its dorsoventral diameter; its vertical diameter is 2 millimeters.

The study of the nasal cavity by dissection is incomplete as the principal cavity, to be described, cannot be seen. It is only by transverse histologic sections that we can see all the details of the olfactory apparatus. We have always used formic acid for decalcification before subjecting the specimens to the various manipulations necessary for paraffin imbedding.

On a transverse section through the middle part of the cavity, the main cavity may be seen communicating, at the external border of the floor, with a large hollow cavity in the facial bones, which has a large transverse diameter and is concave inferiorly. This accessory cavity presents an internal portion adjacent to the main part and an external portion, directed towards the side of the head, whose outlines (Fig. 10) are parallel with those of the head itself.

Transverse sections made anterior to the orifice of communication between these two cavities show the main cavity communicating extensively with an inferior diverticulum, while the accessory cavity is completely closed and diminishing in measure as it approaches the anterior border. Behind the zone of communication, the accessory cavity is modified; the lumen of its internal portion disappears, a large glandular mass taking its place. The external portion forms a diverticulum of the main cavity, extending backward to the level of the choana.

Posterior sections at the choana show only the main cavity with a very regularly elliptical form. We can study the general anatomic construction of the nasal apparatus better by transverse sections than in any other way.

CARTILAGINOUS SHEATH.—In a large part of its extent, the nasal cavity and its diverticula are surrounded by cartilaginous bands. In Fig. 10, we see a mass occupying the median line in the form of a septal partition from which the laminae extend externally. A lamina, prolonging the posterior border of the septum, forms the roof of the nasal cavity, and ends in the vicinity of the supero-external angle of this cavity. A middle lamina extends from the external border, in a slightly oblique direction inferiorly and externally, and then extends horizontally. It separates the nasal cavity from the adjacent diverticulum and borders internally the orifice of communication between the two cavities. Upon the same horizontal plane, another fragment of cartilage borders this orifice externally. An inferior lamina, continuing the inferior border of the septum externally and below, forms the floor of the inferior diverticulum and at the same time the framework of the roof of the mouth. At this place, the external wall and a portion of the roof of the nasal cavity are divested of their cartilaginous envelope, likewise the outer part of the inferior diverticulum. The appearance of this cartilaginous investment depends upon the particular transverse section considered. In the most anterior sections it is complete, and is moulded to the nasal cavities. The inferior lamina is very large in the anterior portion of the nasal region and the inferior diverticulum is completely ensheathed. At the orifices, there is a sudden interruption in the cartilaginous wall, but the area divested of cartilage is larger in extent than the orifices themselves.

Behind, the cartilaginous sac has a large opening externally and inferiorly, so that the external diverticulum is free of cartilage in its entire periphery and a large portion of the buccal roof is formed of soft parts alone. It is in this zone that the choana opens.

Finally, behind this, the cartilaginous lamina of the buccal roof is once more of great size and the nasal cavity, single at this level, is once more completely encapsulated.

Born gives a lengthy description of the cartilaginous framework of the nasal fossae: "The nasal cavities are separated from one another by a septum of hyalin cartilage and at their anterior and posterior extremities are surrounded by two cartilaginous shells, extending from the septum, which are united to each other by a slight roof along the septum and by a floor complete in front and cut off by the chonae behind."

Ecker describes and depicts the cartilaginous framework of the cranium as constituted by laminae which fill up the interosseous spaces. His figures are views of the surface which show well the importance of this supporting tissue, which is indispensable for enclosing and protecting the cephalic organs contained in bony spaces with very incomplete walls. It is these bony walls which serve to support the cartilaginous skeleton.

Bony Skeleton.—In the nasal region, the bony limits anteriorly are the intermaxillary and the maxillary bones, internally the intermaxillary, behind the *os en ceinture* (frontoparietal) and the prefrontal and below the palate and vomer.

Intermaxillary.—Single bone, presenting a posterior part, flattened from above downward, situated in a horizontal plane, becoming more attenuated as the posterior end is approached, having a superior surface, with a median groove formed by two longitudinal ridges and an inferior concave surface. The anterior part of the bone is enlarged, is directed obliquely forward and downwards and presents a free border armed with teeth. It articulates behind with the *os en ceinture* and laterally with the superior maxillary bones.

Superior Maxillary.—Bilateral, elongated, flattened laterally, straight, slender, with smooth surfaces inclined from above downwards and from within outwards, with a posterior extremity prolonged outward as a spur. It articulates anteriorly with the intermaxillary bone, posteriorly with the pterygoid, at the center of its superior border with the prefrontal and at the same level, upon its internal surface, with the palate. The inferior border is provided with teeth.

Os en Ceinture.—As designated by Cuvier, this bone represents the frontals, parietals and ethmoid. Ecker describes separately the fronto-parietals and ethmoid. This bone, which is large, has a groove, in the median line, on the superior surface and is bent around at the level of its anterior extremity so as to change its plane and is directed backwards towards the sphenoid, with the point of which it unites. The anterior extremity, which, alone, takes part in forming the nasal skeleton, presents a median ridge separating two very deep grooves which constitute the base of each nasal cavity. In the center of this depression is an orifice for the passage of the olfactory nerve.

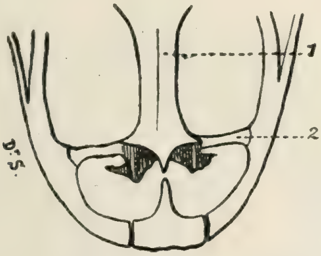

Fig. 8. Natural size. Frog (dorsal surface of skull). 1. Os en ceinture (fronto-parietal); 2. Prefrontal.

Prefrontal (Fig. 8.).—(Frontal-nasal of Ecker.)—Bilateral, quadrangular, slender, directed transversely, situated immediately beneath the skin adjacent to the palate, with which it is almost parallel. It passes from about the middle of the superior border of the maxillary to articulate with the antero-external angle of the *os en ceinture.* It forms a simple truss upon the nasal roof.

Palate.—Bilateral, flattened, slender, directed transversely, passing from the middle of the superior border of the maxillary a little in front and below the prefrontal to the inferior surface of the *os en ceinture.* It is more slender in its middle portion than at either end.

Vomer (Fig. 9).—The vomer is a bilateral bone placed on the same plane as the corresponding palate, presenting two surfaces almost smooth, one superior and the other inferior. It has an antero-posterior diameter of three millimeters and a transverse diameter of two. Its anterior border runs obliquely downwards, its posterior border is united with the palate and the adjacent portion of the *os en ceinture.* The antero-external and antero-internal angles present long osseous points, an intermediate point originating on its anterior border. The inferior surface is provided with teeth.

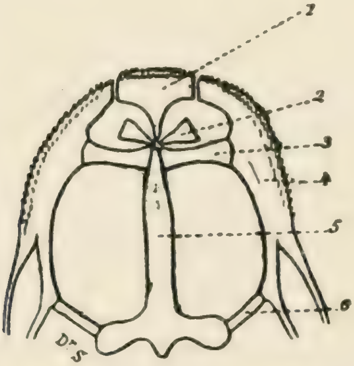

Fig. 9. Natural Size. Frog (inferior surface of cephalic skeleton). 1. Intermaxillary; 2. Vomer; 3. Palatal; 4. Superior maxillary; 5. Sphenoid; 6. Pterygoid.

The maxillary and intermaxillary are united to form the arch of the upper lip. The *os en ceinture* and superimposed pterygoid constitute a thick column upon which the prefrontals, palate and vomers rest. A true osseous nasal cavity does not exist. It is a simple interspace in which the cartilaginous capsule is placed.

Wiedersheim (1877) presents an extensive, well-illustrated study of the skull in the urodeles. In Menobranchus lateralis, the nasal capsule is limited anteriorly by the intermaxillary or premaxillary, superiorly by the frontal and inferiorly by the vomer. The bones are large; they surround nasal fossae which are much more complete. In Batrachoseps attenuatus, the large bones of the superior wall are the premaxillary, with a large, long ascending process directed posteriorly, upon each side of which the nasal bones are placed. Between the nasal and maxillary, there is a small bone, the prefrontal. The inferior wall is formed by the vomer. The internal half of the bone is prolonged posteriorly and this portion has teeth upon its posterior edge.

Triton viridiscens has very large nasal bones in contact along their internal border, the ascending process of the premaxillary filling up the defect. On the other hand, the premaxillary is very much spread out upon its inferior surface, which has a quadrangular form. The vomer, which is very large, is hollowed out upon its posterior border in order to permit the choanae to pass; the postero-internal angle is prolonged backward in the form of a long apophysis resting against the inferior surface of the parasphenoid.

The species examined by Wiedershein are numerous. All possess a nasal skeleton arranged in such a manner as to limit the true nasal cavities.

NASAL MUCOSA.—The cells of the nasal epithelium are arranged by Exner in two groups: epithelial cells and olfactory cells. Max Schultze and Hoffmann do not agree with this author, but admit two very distinct forms of cells. Max Schultze in Proteus described olfactory cells and supporting cells. Babuchin found olfactory cilia upon the olfactory cells and established the absence of vibratile cilia on the supporting cells. Blaue (1884) studied the mucosa of the lower Amphibia, and found, particularly in Proteus, numerous points of resemblance with that of the plagiostomes. There are folds, of slight height it is true, covered with stratified epithelium with flattened cells. The most superficial cells have a cubical form and their free surface permits the implantation of vibratile cilia.

In the interval of the folds, exist the long cells described by Schultze and Babuchin, disposed in groups forming olfactory buds. Blaue represents them in several plates. The buds have the same appearance as those of fish. In the triton and salamander, the essential details are analogous.

The Anura have two kinds of cells; epithelial cells or supporting cells (Ecker, Vogt and Yung) described by Exner, Max Schultze and Hoffmann. The first are long and slender with a large nucleus forming an ovoid enlargement from which the cell is prolonged in the form of a long varicose filament, which comes into relation with the filaments of the olfactory nerve. The extremity which is directed towards the nasal lumen appears either as a brush with delicate hairs or as a single stiff hair. The other cells, which are cylindrical, long and unprovided with cilia, are prolonged into the subjacent connective tissue by a long and irregular filament. In the lower Amphibia, the epithelium is uniform in the nasal cavities. There is no distinction possible between the respiratory and olfactory epithelium. In the urodeles (triton), however, Mihalkovics (1899) found that the epithelium over the greater portion of the lateral fossa has the characteristics of respiratory epithelium, with mucous secretion. There were remains of the rays of olfactory epithelium. The branches of the olfactory nerve, according to this author, extended only

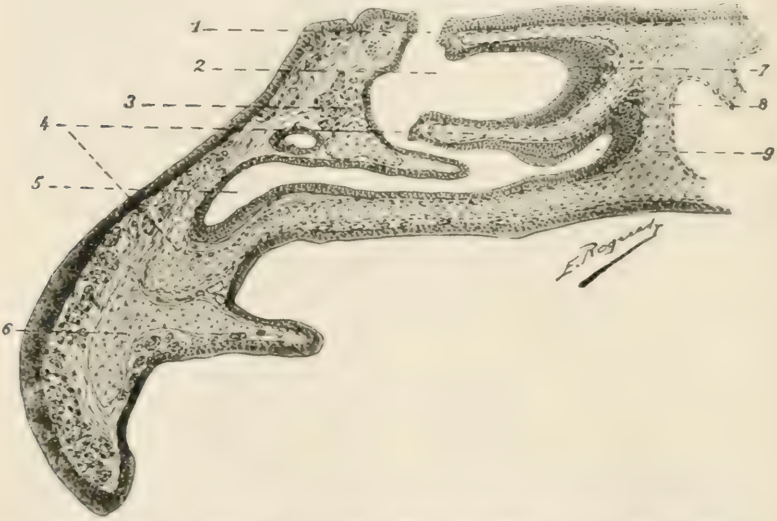

Fig. 10—X 27. Frog (transverse section showing the nasal cavity opening externally and communicating with the inferior cul-de-sac). 1. External nasal orifice; 2. Principal nasal cavity; 3. External nasal gland; 4. Cartilaginous capsule; 5. Infero-external cul-de-sac; 6. Superior maxillary; 7. Olfactory region; 8. Cartilaginous septum; 9. Infero-internal cul-de-sac (organ of Jacobson).

to the roof of the lateral fossa. In the Anura, there is a very distinct demarcation between the respiratory epithelium and the olfactory epithelium in the principal nasal cavity and in the accessory. Seydel considers the epithelium as olfactory in the entire extent of the accessory cavities. Mihalkovics reports the existence of an indifferent epithelium throughout the external region (recessus maxillaris).

According to my observations upon different Amphibia, the nasal epithelium is characterized by cylindrical elements such as those described by the preceding authors. Their topographic distribution presents some differences when comparing one group with another. In the urodeles (axolotl, triton), the nasal cavity and the diverticulum which it sends downwards and outwards are covered uniformly with the same type of cylindrical epithelium with very long cells. In the axolotl, however, the highest points of the nasal mucosa are less prominent.

In the frog, it is necessary to distinguish several regions in the nasal organ (Fig. 10). The principal cavity is entirely covered with thick epithelium of which the superficial elements are cylindrical. These elements, as in the urodeles, and for that matter in all the vertebrates, present a clear, homogenous, pinkish gray central segment.

The thickness of the epithelium upon the internal wall reaches 135 mikra. As it approaches the external nasal orifice, the epithelium is gradually lessened, forming a covering 21 mikra in thickness composed of two or three layers of polyhedral cells with large nuclei. In the infero-internal cul-de-sac, the epithelium, which is very thick (150 mikra), is of a sensory nature. It is here that the cells are highest, reaching 40 mikra. In the middle and infero-external cul-de-sacs, the epithelium, about 35 mikra in thickness, presents a superficial layer of cubical ciliated cells. At the level of the choanae, the thick epithelium of the principal nasal cavity is gradually merged into the buccal epithelium.

Glands.—In the vicinity of the buccal and nasal cavities, numerous glands are found in the Amphibia. In the frog and toad, the entire mouth and the region anterior to the nasal sacs are occupied by an enormous number of cul-de-sacs and glandular ducts. Several groups are connected with the nasal mucosa. Born and Ecker have studied these. Two groups correspond to the nasal cavity and two other groups to the buccal cavity. Upon transverse sections three groups (Fig. 10) are found: an external placed upon the external wall of the nasal cavity, composed of a large number of tubes agglomerated into a mass with quadrangular form, bounded above by the nasal vestibule (a portion of the cavity which is directed towards the depression of the skin which corresponds to the external nasal orifice), externally by the integument, internally by the nasal mucosa, inferiorly by a portion of the cartilaginous capsule. This is the superior gland of Born, whose ducts are situated around the lachrymal canal.

An inferior group is placed above and within the inferior extremity of the infero-external diverticulum. A fibrous band limits this glandular mass and permits it to be in direct connection with the mucosa of the diverticulum, altogether removing it from the buccal cavity. This group, very extensive antero-posteriorly, is in connection posteriorly with the buccal roof. It is the pharyngeal gland of Born which, at its anterior portion, approaches the buccal mucosa and merges with the median mass situated anterior to the cartilaginous capsule. This median mass, which is far anterior, is prolonged posteriorly below the nasal septum and is the intermaxillary gland of Born.

An internal group, placed upon the septum in the cartilaginous capsule of the infero-internal cul-de-sac and represented in Fig. 10 only by some tubes, acquires, in the posterior sections, considerable importance and fills up the entire posterior part of the diverticulum corresponding to the fibrous capsule. This is the inferior gland of Born.

The nasal glands comprise the external or superior gland and the internal or inferior gland. The intermaxillary is a buccal gland, but Born describes it as having numerous openings in the inferior cul-de-sac. The inferior or pharyngeal gland opens into the infero-external cul-de-sac and into the buccal cavity. The groups scattered along the buccal roof, especially in the anterior portion, end in the buccal cavity.

The glands are less abundant in the triton. Two important groups are found: the external gland, the ducts of which form a true diverticulum of the nasal cavity; the intermaxillary gland, well developed and exclusively buccal, except some tubes scattered upon the anterior part of the palatal vault. Their arrangement is almost analogous to that of axolotl.

According to the investigations of Blaue, the lower Amphibia, such as the proteus, do not have any glandular formation.

The glandular cells in all of these groups are cylindrical and have a nucleus situated in the basal part and an extremity, directed towards the lumen, clear and filled with homogenous protoplasm. These are mucous cells. Their existence is a formal indication of the adaptation of the animal to life in the air. According to Bruner, the muscles around the external nasal orifice evacuate the mucus of the external nasal gland into the nasal cavity at the moment when they contract so as to close this orifice when the animal plunges into the water.

Nasal Cavity.—We have already described in the nasal cavity a principal portion and two diverticula: an inferior diverticulum and a middle diverticulum interposed in the anterior region between the nasal cavity proper and the inferior diverticulum, and branching from the canal of communication between the two cavities. The middle diverticulum, or lateral diverticulum of Born, is at no point entirely covered by cartilage; its external wall is always uncovered; it is in relation with the cul-de-sacs of the external gland and with the lachrymal canal; it is the first step towards perfecting the nasal cavity, and thus increases its respiratory region. According to Seydel, the existence of this cul-de-sac is intimately connected with that of the lachrymal canal; it is absent in the proteus and siren, which have no lachrymal canal, and also in the Gymnophiona, in which the lachrymal canal opens into the organ of Jacobson. This extension is still further manifested by the presence of the inferior cul-de-sac. This begins in front of the anterior extremity of the nasal cavity proper and extends to the choanae. Its transverse extent is considerable; we may observe two portions: an internal between the septum and the canal of union to the nasal cavity, and an external situated external to the canal and extended far externally and inferiorly almost to the maxillary bone. The internal portion is shorter than the nasal cavity and the external portion; it terminates a little in front of the choanae. Therefore, in a posterior section in the neighborhood of this orifice, two cavities are to be seen: a large one, internal and superior, the nasal cavity; another external and inferior, the infero-external diverticulum, which Seydel calls the lateral nasal canal; this is the portion which extends to the posterior limit of the choanae. Born (1876) attributes to the inferior cul-de-sac the importance of a maxillary cavity homologous to the sinus maxillaris of mammals. The direct relation of this to the buccal cavity at the level of the choanae, according to him, depends upon the shortness of the frog's palate; the length of the palate in the higher vertebrates brings the maxillary cavity into exclusive relation with the nasal cavity.

According to Seydel, the inferior cul-de-sac represents the organ of Jacobson. Goette, Fleischer, Koelliker had already expressed this opinion. The Sarazin brothers considered the middle cul-de-sac homologous with this organ. The investigations of Seydel were made upon the entire series of Amphibia: Perennibranchiata, Gymnophiona, Urodela, Anura. He showed in all of these the existence of a fossa (diverticulum upon transverse sections) situated in the inferior part of the nasal cavity, beginning forward in a cul-de-sac and terminating posteriorly in the choanae, in which it opens extensively. This fossa, which is simple in the three first groups, is complicated in the Anura, in which it forms a true inferior cavity which possesses, as we have seen, external and internal diverticula. But this inferior cul-de-sac, according to Seydel, from its position and connection, is homologous to the fossae of the other groups. These formations covered with sensory epithelium and receiving the branches of the olfactory nerve, constitute an olfactory region placed in the passage for the respiratory air in order to exercise a sensory control. Burckhardt (1891), who described this fossa in the triton, demonstrated its innervation from the olfactory nerve and considered it the organ of Jacobson. Wiedersheim (1902) accords to it the same function.

The absence of a fossa of this sort in Proteus and Menobranchus, established by Seydel, is a new proof demonstrating their more primitive organization. It is the increasing extension of this fossa which causes the complicated disposition in the higher forms.

In the triton, there is a fossa placed at the infero-external angle of the nasal cavity passing outward into the maxillary region in continuous communication with the nasal cavity and terminating at the level of the choanae. This fossa, as in the inferior cul-de-sac of the Anura, has, according to our observation, for its principal role the enlargement of the respiratory region and its constant termination at the level of the choanae seems to us to be in favor of this function. In the lower species, in which the division of the nasal mucosa into olfactory and respiratory zones is not established, the fossa has the function of participating in the olfactory sense, but it is not organized into a true organ of Jacobson. Mihalkovics (1899) refuses to accord to this fossa, as Seydel does, the value of an organ of Jacobson. The distant position of the septum and the presence of respiratory epithelium in this zone has made him insist that it represents the recessus maxillaris.

In Anura (Rana esculenta, Bufo vulgaris), a portion of the inferior cul-de-sac is differentiated and one could say that in these animals it appears as a true organ of Jacobson. It is the internal segment (infero-internal diverticulum) of the inferior cul-de-sac which we consider thus. The epithelium at this level has all the character of a sensorial epithelium. It is on the presence of this epithelium localized in the infero-internal diverticulum that Mihalkovics has based his opinion that the organ of Jacobson is confined to that part of the inferior diverticulum. A very important gland, the internal gland, opens into this diverticulum. Seydel observed it in relation to the inferior cul-de-sac and called it the gland of Jacobson. Burckhardt and, later, Seydel found these glandular cul-de-sacs in relation with the fossa in the urodeles, and gave to them the same denomination as in the Anura.

With regard to the exterior portion of the inferior cul-de-sac of the Anura, we consider it as forming a simple extension of the respiratory region. The functional division of this cul-de-sac agrees with the respiratory role of the nasal cavity.

Seydel does not admit the homology of the inferior cul-de-sac with the sinus maxillaris of mammals as Born claims. It is, nevertheless, the first appearance of an exclusively respiratory region, which represents not a true sinus maxillaris, but rather a zone which, in reptiles, birds and mammals, is situated below the inferior turbinate.

The nasal cavity of the axolotl closely resembles that of triton, showing the same external cul-de-sac. The epithelial wall is very thick, averaging 300 mikra. The nasal lumen is effected by the sinking in of the thick portions of this wall in the form of fissures. Between these fissures, the distribution of which is very irregular, are found circumscribed folds with a thick base. At the summit of the projecting portions, the thickness of the epithelium is only 75 mikra. The projections represent the folds of the nasal mucosa of fish, and constitute a morphologic character, permitting the grouping of the water-breathing animals with those of the air-breathing class.

REPTILES.

We have studied especially the saurophidians and the crocodilians; we have made few observations on the chelonians.

I. SAUROPHIDIANS.

The adder, blindworm, viper, python, boa and the galeote form the basis of our description. The nasal organ in these animals has pretty much the same disposition.

ORIFICES.—The external orifice in the adder is pierced in the center by a scale in the neighborhood of the end of the snout, upon the lateral side of the head. This orifice, which is circular, surrounded anteriorly, superiorly and inferiorly by a very distinct border, does not project beyond the plane of the integument, but is in distinct relief, and has no border internally and posteriorly, where the surface of the scale forms the limit of the orifice. In the python, this orifice is placed upon the dorsal surface of the snout.

The galeote presents an external orifice pierced at the center by a scale; it is round, very distinctly limited throughout its periphery, and is placed midway between the anterior border of the orbit and the end of the snout upon the line of separation between the dorsal and external surfaces.

A large number of observers have reported that reptiles which live in the water have nasal orifices placed upon the dorsal surface of the head—they need expose but a small portion of the snout in order to breathe the air. To prevent the water penetrating the nasal cavities when the animal plunges into the water, there is a sort of valve at the edge of the external orifice. According to Cantor, a valve is present; according to Duméril and Bibron, there are movable membranes which take the place of valves. Schmidt, Pagenstecher, Hoffmann, Brehm, Fleischmann and Kathariner (1900) report a valve as present. Furthermore, Kathariner describes an arrangement which constantly and without expenditure of muscular work closes the nasal orifice and accomplishes the necessary work when the air passages need to be opened for the purposes of respiration.

The posterior orifice of the ophidians opens at the level of the palatal vault in an antero-posterior fossa, limited above by the palatal vault, below by a kind of transverse membrane extending from one to the other of the projections which border the fossa laterally. At its anterior extremity, this communicates with each nasal cavity by a large orifice situated in a plane oblique from above downward and from behind forward. This canal, separated from the buccal cavity where the choanae open, is found in all the ophidians. The choanae of the galeote are placed on the anterior third of the palatal vault; they are elliptical orifices with the long axis antero-posteriorly, opening freely into the buccal cavity, and are placed immediately external to a median ridge of the palatal vault, which supports two round tubercles. This is the usual disposition of the choanae of the saurians.

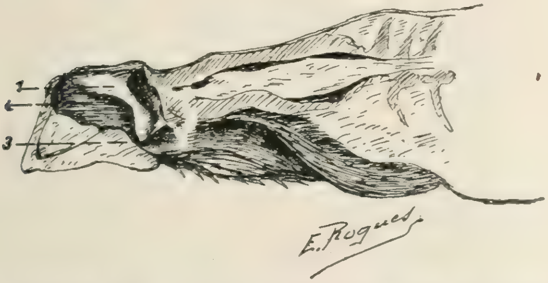

Fig. 11. Natural size. Python (Sagittal section showing the external wall of the nasal cavity with the turbinal). 1. Turbinal; 2. Vestibular orifice; 3. Choana.

Nasal Cavity.—From the external orifice, we enter an almost cylindrical passage, which opens inferiorly and posteriorly into the nasal cavity proper. This is the vestibule described by Leydig (1872) and Born (1879). In the python, a large, round orifice establishes the communication of the vestibular passage-way with the nasal cavity. The blindworm has a vestibule less distinctly separated from the nasal cavity. It is simply the anterior portion narrowed. The histologic characteristics permit this distinction between the two spaces, which is also found in the adder. Leydig, in Lacerta, describes the vestibule as a passage-way slightly elevated, which connects a fossa with the external nasal orifice.

Solger (1876), in Lacerta, Anguis, Leguan, Chameleo, Hemidactylus, showed that the two nasal spaces communicate by a more or less narrow orifice, which runs in various planes, e. g., parallel to the longitudinal diameter of the head (Laguan), or to the transverse diameter (Lacerta), or even oblique (Chameleo). This author remarks the constant absence of a vestibular turbinal analogous to that which we shall describe in birds.

The principal nasal cavity is quadrilateral in form and, with the vestibule, consists of a long cartilaginous sac. The external wall in the python (Fig. 11) presents a cartilaginous fold, the turbinal, which is free at its superior border, adherent at its inferior border and extremities. We find it in the boa; it is very much reduced in the adder and in the galeote, but it attains a considerable importance in the blind-worm. Stannius, Leydig, Born, Gegenbaur and Solger have described this single turbinal in reptiles. Born studied minutely the turbinal of Lacerta and notes its rectangular deflection. In the blind-worm, the turbinal, by its anterior extremity, forms a simple prominence on the lateral wall, then progressing backwards is elevated, pedunculated and rolled up (Fig. 12). On transverse sections in the middle portion, the turbinal appears as a graceful projection arising from the inferior portion of the external wall directed internally and superiorly, then becoming bent and directed internally and inferiorly. It presents a free border looking downward and considerably enlarged. At the posterior portion of the cavity, the turbinal is prolonged behind by its pedicle in such a way that transverse sections at this level show the turbinal isolated in the center of the nasal cavity.

According to the definition of Gegenbaur, the turbinal should be a projection extending from the nasal wall by a narrow portion. Solger and Mihalkovics did not find this characteristic in that of reptiles, and called it a false turbinal (pseudoconcha of Solger), comparable to the superior turbinal of birds. If their observation is correct for a number of types, galeote and adder, it is not the case with the python and still less with the blind-worm. It is only necessary to compare Figs. 12, 18 and 20 to see the resemblance which exists between the turbinal of this animal, the middle turbinal of birds and any turbinal of the mammals. By its position and great development, it appears to correspond to the maxillary turbinal of the mammals.

No hollow cavity is found in the bones or cartilages of the nasal region. There is no homologue of the infero-external diverticulum of amphibians or the sinuses of birds and mammals. In the anterior vestibular region there is found under the cartilaginous floor of the nasal cavity, situated near the septum, a passage-way with thick walls, which anteriorly and posteriorly is represented by a solid mass. The lumen of this passage-way is narrow in comparison to the thickness of its walls. The superior wall is the thickest. The inferior wall in its middle portion is projected into the lumen in the form of a convex pad, resembling a mushroom in transverse section. At this level, the lumen upon transverse section is reduced to a fissure with inferior concavity. This passage-way is the organ of Jacobson. Behind the mushroom-like pad, the floor presents a narrow fissure which establishes

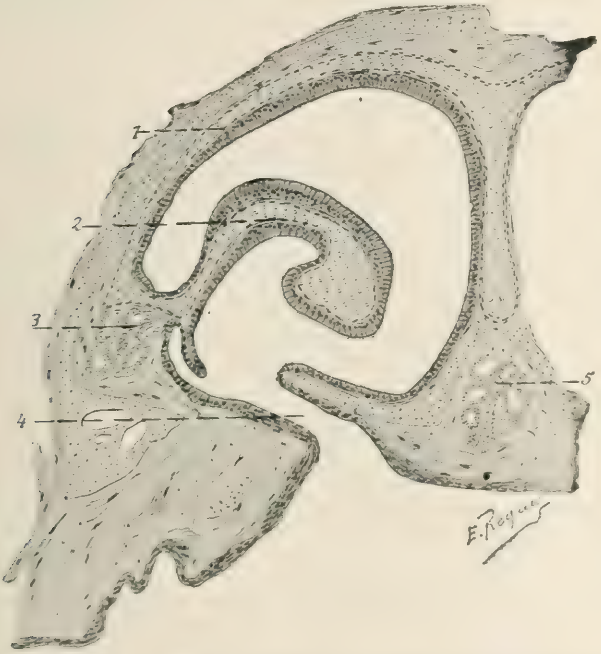

Fig. 12—X 34.3. Adder (transverse section of the nasal cavity, turbinal and choanal canal). 1. Cartilaginous capsule; 2. Turbinal; 3. External nasal gland; 4. Choanal canal; 5. Intermaxillary gland.

the communication with the buccal cavity. Mihalkovics found this orifice in the lizard upon the side of the palatal papilla. The cartilaginous nasal septum separates the two organs of Jacobson. A cartilaginous box envelopes this organ and separates it from the nasal cavity on one side and from the buccal roof on the other. The posterior extremity of the organ of Jacobson corresponds to the anterior part of the turbinal. The different ophidians and saurians studied by Leydig (1897), Born (1879), Beard (1888) and Mihalkovics (1899) possess a well-developed organ of Jacobson, analogous to that of the blind-worm.

NASAL SKELETON.—The nasal cavity is completely enveloped in a cartilaginous sac which follows all of its contours. Internally the two sacs are fused, forming the septal wall, which is greatly extended vertically, even to the buccal roof. The external wall of the nasal cartilage sends out a lamella which becomes the axis of the turbinal. In the posterior part of the nasal cavity, the cartilage becomes thin near the floor and disappears in such a manner that the nasal mucosa and the buccal mucosa are attached to each other in the neighborhood of the choanae.

The bones of the nasal region lie external to the cartilaginous wall. We studied these bones in a python of large dimensions. The nasal cavity is bounded above by the nasal and prefrontal, internally by the vertical plate of the nasal, the vomer and the intermaxillary, below by the vomer and palate and externally by the prefrontal and maxillary (Fig. 13).

Intermaxillary.—Small, single bone composed of two parts, of which the posterior, flattened and arranged as a vertical lamina, is connected to the other which forms a transverse wall, upon the inferior surface of which the teeth are implanted. Laterally, it is united with the maxillary.

Maxillary.—Double bone, compact, elevated in front, becoming thinned out at its posterior extremity. The external face, which is smooth, is slightly oblique from above downward and from within outward. The internal face is smooth and slightly excavated. The inferior border is supplied with teeth. The round exterior extremity unites loosely with the intermaxillary. The posterior extremity is united with the transverse portion and the middle portion of the superior border with the prefrontal. It unites with the palate by a ridge on the internal surface near the superior border.

Palate.—Double bone, slender, almost cylindrical, with the inferior surface flattened and supplied with teeth. A prolongation from the internal border articulates with the posterior extremity of the vomer and the anterior extremity of the sphenoid. This prolongation is situated in the posterior third of the bone. The anterior extremity is free and the posterior extremity is articulated with the pterygoid. The middle portion of external border is in contact with the maxillary.

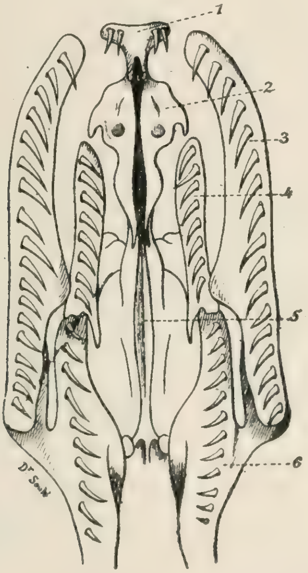

Fig. 13. Two-thirds natural size. Python (skull seen from its inferior surface). 1. Intermaxillary; 2. Vomer; 3. Superior maxillary; 4. Palatal; 5. Sphenoid; 6. Pterygoid.

Vomer.—Double bone as in the amphibians, formed of two laminae, the vertical one contributing to form the nasal septum in connection with that of the opposite side, and a lamina directed horizontally outward, with the superior surface concave and limited by a greatly elevated external border. This lamina exists only in the anterior third of the bone, but its border is prolonged backwards under the form of a very slender process. The bone has the shape of a fish hook. The vomer articulates above with the nasal, externally with the prefrontal and posteriorly with the inferior surface of the sphenoid.

Nasal.—Double bone, large and slender, with the superior surface convex transversely, while its inferior surface is concave in the same direction. The internal border is rectangular, the external border uniform, so that the bone resembles a crescent. A lamina extends from the internal border vertically downward and joins with the vertical lamina of the vomer. The intermaxillary lies between the anterior extremities of the nasal bones.

Prefrontal.—Double bone, triangular, formed of two laminae, an anterior horizontal, the other almost vertical and directed downward, extending from the posterior border of the bone and constituting an orbital process. The anterior angle of the horizontal lamina is inserted between the frontal and maxillary. The external border is in contact with the nasal bone and the posterior part of the external border with the maxillary. The posterior border or base of the triangle is articulated by its internal half with the frontal, and by its external half aids in forming the orbit. Fischer (1900), in the Amphisboenia, noted the general plan of the structure of the saurians, and described several points of divergence in the skeleton, particularly the imperfect development of the cartilaginous envelope.

NASAL MUCOSA.—In the vestibular region, the mucosa presents a stratified pavement epithelium. At the posterior limit of the vestibule, a transition is effected between this indifferent epithelium and the respiratory epithelium. In this zone, the inferior wall and a part of the internal wall are covered with stratified pavement epithelium, while the superior wall, the external wall and a part of the internal wall are covered with stratified epithelium, of which the most superficial layer is composed of cylindrical, ciliated cells. In the blind-worm, the respiratory region anterior to the turbinal presents a diverticulum placed at the level of the external border of the floor and directed horizontally outward, the lateral recess of Mihalkovics.

All over the turbinal, the mucosa is of the respiratory type. The corium of the turbinal contains numerous blood vessels and glands. The axis of the turbinal is formed by a cartilaginous lamina extending from the nasal capsule, which is of slight thickness but is enlarged at the level of its free border.

The epithelium is very thick, the layers of round cells are very numerous, the superficial layer is formed by very high cells with basal nuclei. They are clear and refractive in their remaining portions. At the level of the nasal roof and of the superior border of the turbinal the thickness of the epithelium is 85 mikra and 50 in the portion adjacent to the turbinal.

In the saurians, Mihalkovics described olfactory epithelium in a considerable portion of the cavity; the respiratory epithelium covers only the inferior surface of the turbinal. This author finds many Bowman's glands in the olfactory mucosa.

Max Schultze describes, in the adder, blind-worm and lizard, cylindrical epithelial cells which never have any vibratory cilia, and olfactory cells provided with a bundle of long cilia.

GLANDS.—The mucosa of the blind-worm contains in the corium some few glandular tubes which are found along the external and internal walls. There is only one large gland in relation with the nasal cavity, which is situated externally towards the middle portion of the external wall. This glandular group begins at the level of the posterior portion of the vestibule and acquires a considerable importance at the level of the lateral diverticulum of the respiratory region, and continues as far as the middle of the turbinal.

ORGAN OF JACOBSON.—We have seen the situation and form of the long canal; it is enveloped in a cartilaginous tube which is connected with the septum and the nasal capsule. The vomer and the palate are the bones protecting this cartilaginous envelope inferiorly and internally.

Leydig (1897) describes, at length, the organ of Jacobson in serpents. Two bones are in relation with it, the turbinal and the vomer; its cartilaginous wall is connected above with the nasal cartilage. Mihalkovics (1900), in the adder and Lacerta agilis, represents and describes the vomer as forming the roof of the organ of Jacobson, which it separates from the nasal cavity, and the intermaxillary as constituting a part of the floor and of the internal wall.

Internally, the cartilaginous wall presents a mucosa with a very thin corium and very thick epithelium. On the dorsal wall, the thickness of the epithelium is 257 mikra and on the ventral 42. We find in the blind-worm and viper, at the level of the dorsal wall, a large quantity of round cells, crowded closely together. The superficial layer is composed of very high cells (54 mikra), having a basal nucleus, clear in the remaining portion. At the level of the floor, and especially on the ridge which it forms in the cavity, the epithelium is much thinner than that of the roof; the cells have a superficial clear segment and terminate in a border supporting the cilia; their height is 16 mikra.

Wright (1883) describes a well-developed neuroepithelium upon the roof of the canal of Jacobson, while the floor is covered with an epithelium composed of shorter cells provided with cilia. Leydig found cylindrical cells in the epithelium of Jacobson, and described numerous fibres of the olfactory nerve and nerve cells in the corium. Mihalkovics found cells with cilia of various lengths in the epithelium of the floor. In several places, there was a slightly elevated cuticle upon the superior wall. He found, at the external limit of the layers of small cells, a capillary network in which the branches penetrated in a radiate direction into this layer. The olfactory cells showed the limiting membrane of Brunn through which the fine, short olfactory filaments projected.

The organ of Jacobson is greatly developed among the saurophidians, and Beard accounts for the relative simplicity of the nasal cavity on this ground.

Mihalkovics (1899) notes the narrow communication of the organ of Jacobson with the buccal cavity in serpents, but does not agree as to this organ with the opinion of Seydel, who accorded to it, in the Amphibia, the role of sensory control of the expiratory current. He considers it an organ whose purpose is to perceive genital odors, which are well developed in all crawling animals, being absent in fish and birds, which have recourse to their visual apparatus, and atrophied in man because of the development of the intelligence and the retrogression of the olfactory powers.

II. Crocodilia.

The nasal fossae of the crocodile are more complex than those of other reptiles. The external nasal orifices are placed upon the dorsal surface of the snout in the vicinity of the anterior extremity and almost in the median line. They are of small dimensions, of elliptical form and directed obliquely from within outward and from behind forward. The choanae open upon a plane horizontally placed upon the prolongation of the palatal vault; they are situated about 2.5 cm. from the insertion of the palate. They are of quadrangular form and have bony boundaries throughout.

The external orifice begins as a vertical canal about 1 cm. in height and bends so as to become horizontal, making a sort of nasal vestibule. Its dimensions increase from before backwards and it becomes a very large cavity, especially in a vertical direction This cavity contains a long, large, round ridge inserted in the roof of the nose, free on its inferior border. It is a true turbinal. This is of cartilaginous consistency. Another ridge occupies the bottom of the cavity formed at the expense of the external surface, upon the entire vertical extent of which it has its insertion. It is a false turbinal according to the definition of Gegenbaur.

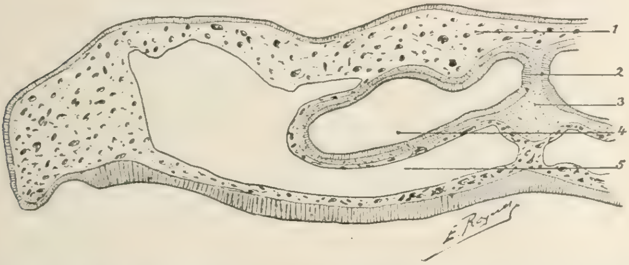

Fig. 14. Half natural size. A. Crocodile (transverse section passing through the anterior region of the nasal cavity). 1. Maxillary; 2. Nasal mucosa; 3. Cartilaginous septum; 4. Nasal lumen; 5. Maxillary cavity.

The floor of the vestibule is convex. Posteriorly, at the limit of the principal nasal cavity, it becomes depressed into a fossa and leads to a cylindrical canal which occupies the most internal and inferior portion of the principal nasal cavity. This canal, circumscribed by an osseous wall, opens into an osseous canal of the same form, but much larger, which terminates in the choanae.

The various details may be well seen in a series of transverse sections. Section A (Fig. 14) passes across the vestibule; the section of the cavity is elliptical. It is surrounded by a cartilaginous wall. Internally this forms a septum. The floor is entirely cartilaginous. At the level of the roof and externally, a very thick osseous wall is observed. The very large maxillary cavity is situated external and inferior to the vestibule. Section B (Fig. 15) shows the principal nasal region. The nasal cavity has an irregular form and presents the turbinal which is pedunculated, has an axial cartilaginous skeleton and is inserted on the dorsal region of the nasal capsule. The external wall is markedly convex and cartilaginous, and is constituted by the surface of the false turbinal, which is hollow. Its cavity appears on section. The inferior half of the internal wall is also convex, due to a cylindrical osseous canal placed below the septum and adjoining a similar canal on the opposite side. The posterior portion of the cavity is a simple cylindrical osseous canal covered with a thin mucosa, analogous to periosteum.

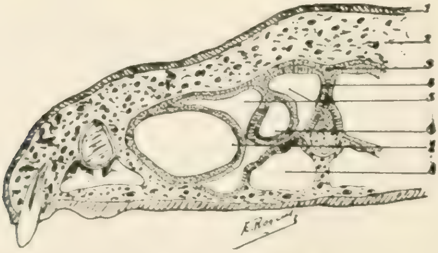

Fig. 15. Half natural size. B. Crocodile (transverse section passing through the middle portion of nasal cavity). 1. Skin; 2. Superior maxillary; 3. Cartilaginous capsule; 4. Nasal mucosa; 5. Olfactory region of the nasal cavity; 6. Turbinal; 7. False turbinal; 8. Respiratory region of the nasal cavity.

As Section B and the antero-posterior sections show, there are two small nasal cavities behind the vestibule. The cavity containing the turbinals terminates in a cul-de-sac and the cylindrical cavity, prolonged posteriorly, which leads the respiratory current directly from the vestibule to the choanae. The olfactory apparatus is distributed only to the principal nasal cavity which contains the olfactory nerve. The superposition and complete separation of the olfactory cavity from the respiratory cavity is very remarkable and does not exist anywhere else. In the tortoise, this division is well established, but the two canals communicate with one another.

The respiratory canal is bony; the other is cartilaginous and completely surrounded by very large and thick bones.

Nasal Skeleton.—The bones bounding the nasal cavity are superiorly the nasal, prefrontal, a part of the maxillary and the intermaxillary; inferiorly the intermaxillary and the palatal lamina of the maxillary; externally the maxillary, internally the cartilaginous septum. The interior of the cavity thus circumscribed encloses the respiratory region, limited by the ethmoid and the palatal in its anterior half, and hollowed out of the pterygoids in the posterior region (Fig. 16).

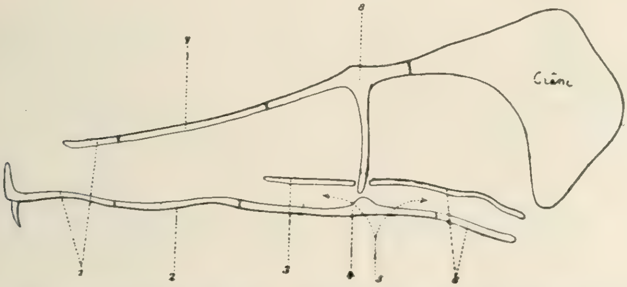

Fig. 16. Half natural size. Crocodile (Sagittal section of the skull passing somewhat external to the median line). 1. Intermaxillary; 2. Palatal lamina of the maxillary; 3. Ethmoid; 4. Palatal; 5. Respiratory region of the nose; 6. Pterygoid; 7. Nasal; 8. Prefrontal.

Intermaxillary.—A double bone, of which one wall constitutes the external surface and inferior border, the latter provided with teeth. The external surface is rough, a characteristic found in all the bones immediately subjacent to the skin. The palatal lamina, directed horizontally inward, extends from the lower border of this wall; the free border is thin and hollowed out at the middle portion. The internal surface of the lateral wall is concave vertically. This bone articulates internally with that of the opposite side and posteriorly with the nasal and maxillary.

Nasal.—Double bone, long and flat, trapezoid in form, with a large internal base. The inferior surface is slightly concave transversely. The internal and external borders are rectangular, the anterior and posterior, squamous and bevelled. It articulates internally with the bone of the opposite side, externally with the maxillary, anteriorly with the intermaxillary and posteriorly with the prefrontal and frontal.

Maxillary.—Double bone, of large dimensions, quadrilateral, with rough external and superior walls and an inferior border supplied with teeth. The palatal lamina is flat, its free border rectangular. The internal surface of the bone is concave and forms a longitudinal fossa by uniting with the palatal lamina. It articulates anteriorly with the intermaxillary, posteriorly with the prefrontal, the lachrymal and the jugal, internally with the nasal by its superior border and by the palatal lamina with that of the opposite side.

Prefrontal.—Double bone, limiting the orbital cavity, the inferior surface of which sends out a process directed vertically downwards, which establishes the solid relations between the vault and the nasal floor by articulating with a process of the palate. This bony interval is the posterior limit of the olfactory region.

Palatal.—Double bone, quadrilateral and thin; the internal portion of its superior surface is hollowed out by a longitudinal groove. A thick process is projected vertically upward from its middle portion to articulate with that of the prefrontal. The inferior surface is flat and thin, the internal border rectangular; the external border oblique from without inwards in the anterior half where it is thin. Behind, it is thick. The anterior and posterior borders are divided into lamellae. Internally, it is united with the bone of the opposite side, anteriorly with the palatal plate of the maxillary, posteriorly with the pterygoid, superiorly by its process with the frontal and by the edges of the groove on its superior surface with the ethmoid and pterygoid. It is thus that the respiratory canal is limited.

Ethmoid.—Double bone, long and lamellated; a vertical lamina constitutes the principal part of the bone; its external surface is hollowed out by a groove. About the inferior border and posterior half of the bone, a lamella projects outward and downwards. It is articulated below with the ethmoid of the opposite side, and also with the vomer (median prolongation of the pterygoid); anteriorly it is insinuated between the two palatal laminae of the maxillary; by its posterior border it articulates with the process of the prefrontal. The external lamella articulates with the palate, forming a canal between these two bones.

Pterygoid.—Single bone, large in size, presenting a median body directed antero-posteriorly, which posteriorly stretches out in the form of a wing. It is prolonged anteriorly by a long coping, which represents the vomer (hérisséal of Geoffroy Saint-Hilaire).

The posterior border, which is very thick, presents a median tubercle and is bordered by high ridges. The superior surface presents a median fossa which is prolonged with one hollowed out on the vomer. The inferior surface, which is flat, is enlarged by lateral wings. It presents posteriorly two large orifices of almost quadrangular form which are the choanae. Each of these gives access to the canal hollowed out in the pterygoid. This bone is in relation anteriorly with the ethmoid, and the palate bones of the vomer, with the processes of the frontal and the palate by the lateral ridges, with the palate and the transverse by the anterior border of the wing, above with the pre-sphenoid, the basi-sphenoid and the alisphenoid.

STRUCTURE.—We cannot give the details of the structure of the mucosa of the nasal cavity of the crocodile. We found neither glands nor organ of Jacobson. Beard (1888) found no trace of the organ of Jacobson in the embryo. Howes (1891) described two cartilaginous sacs which represented the vestiges of this organ. Meek, in young embryos with a head measuring 5¾ to 7 mm. in length, considered a small invagination of the inferior part of the nasal cavity as a rudimentary organ of Jacobson.

Sluiter (1892), in young embryos, found an organ of Jacobson well developed, analogous to that of the lizard. There was no trace in old embryos. He concludes from this observation that the ancestors of the crocodile were provided with a perfected organ of Jacobson.

Roese (1893, 1), in a series of embryos having a head from 5 to 12½ mm. in length, describes the organ of Jacobson as an evaginated cul-de-sac of the postero-inferior extremity of the nasal cavity. This evagination will develop into the posterior nasal canal, which in the adult forms the respiratory passage-way. The anterior extremity of the organ projects from the nasal passage-way in the form of a solid epithelial cone. Later, in an embryo with a head measuring 41 mm., the rudimentary organ appears under the form of a mucous fossa 2 mm. in length, lodged in the concavity of the vomer.

The absence of nasal glands in the crocodile is as universally admitted as that of the organ of Jacobson. However, Stannius, Wiedersheim, Gaupp, Roese (1893, 2) described a large gland opening into the nasal cavity.

Roese finds it between the cartilaginous roof and bony layer (premaxillary and nasal). It opens by one or two excretory ducts on each side of the septum in the posterior extremity of the external nasal orifice. This gland appears in the form of an epithelial bud in embryos with the head 12½ mm. in length.

III. CHELONIANS.

According to the nasal skeleton of Testudo mydas, this group of reptiles may be considered as intermediate between the saurophidians and crocodilians.

The choanae open about the middle of the palatal vault and the pterygoid does not participate in the constitution of the hard skeleton as in the crocodile.

The ethmoids are large bones participating in the formation of the nasal fossa. The vomer is enlarged at its posterior extremity and aids in the constitution of the palatal vault. There exists, therefore, in these animals a special respiratory canal, but, according to Wiedersheim, it communicates by several orifices with the remaining portion of the nasal cavity. Seydel, who has studied the nasal cavity of the tortoise with much care, finds an organ of Jacobson well developed in them, in the form of a canal covered with olfactory epithelium. Mihalkovics represents this organ as a diverticulum transformed later into a canal lying against the nasal septum and covered with sensory epithelium.

BIRDS.

The nasal cavities in birds are hollowed out in part in the beak and in part in the facial walls, anterior to the orbital cavity.

Orifices.—The external nasal orifice is variable, in form, dimensions and situation, depending on the species.

Ornithologists distinguish basillar nasal cavities (at the root of the nose) median (at the middle of its length) and marginal (at the borders). They may be round, oval or linear. They are masked by hard plates in the crow, and by cartilaginous scales in the Gallinaceae. They are sometimes very small, as in the heron and pelican (Chatin), at other times freely open, of large dimensions and elliptical, as we have found in the duck. In the turkey, they are provided with a sort of valvular apparatus which protects the entrance of the nasal cavity. This animal has an external elliptical nasal orifice, looking outwards, bordered by a thick integument of dark color and scaly appearance. The framework is cartilaginous; no portion of the border is provided with bony support. A cutaneous fold extends diagonally from before backwards and from below upwards, dividing this orifice into two parts, an external part which is a simple cul-de-sac terminating at the posterior level of the orifice, the other internal, which leads into the nasal vestibule. In the external cul-de-sac, small solid particles (especially dirt) are found, which the anatomic disposition has prevented from entering further into the nasal cavity.

The nasal orifice of the duck, which gets its food at the bottom of muddy ponds, is wide, with no protecting apparatus.

The nasal fossae open together into the buccal cavity by a median fissure of the palatal vault, a simple cleft in the anterior portion, having the appearance of an elliptical buttonhole in the posterior half, in the turkey, duck and pigeon. The border of this orifice is composed of soft parts, of which the free border is provided with very long calcified odontoid papillae. The opening of the larynx in the form of a large elongated cleft is found at the level of the base of the tongue, immediately subjacent to the palatal orifice. The respiratory air passes, therefore, almost directly from the nasal cavity into the larynx. On lifting the borders of the palatal arches, the nasal septum is observed in the median line too short vertically to reach the palatal vault, and on each side are to be seen the nasal cavities with an open floor.

Nasal Cavity.—The nasal cavity has no bony wall, but is, as in Anura, limited by a cartilaginous sac. It is separated from the integument by a large empty space, larger below than above. If it is examined on longitudinal sections made a little external to the septum, it is seen to be considerably elongated in an antero-posterior direction. Its vertical diameter increases progressively from before backwards. An anterior region may be isolated from the rest of the cavity, the vestibule described by Born. Posterior the nasal cavity proper is found. The external wall is the seat of three very prominent ridges projecting into the cavity, representing the true turbinals. The anterior turbinal, inserted in vestibular region, has the name of vestibular turbinal [Born (1879), Gegenbaur (1873), Mihalkovics (1879)]; the two others belong to the principal cavity. In the turkey, the vestibule represents about one-third of the whole cavity. It opens externally by the external nasal orifice, and communicates with the principal nasal cavity by a narrow cleft between the external wall and the posterior border of the vestibular turbinal. This turbinal, which is attached to the roof of the vestibule, is a true fold of the cartilaginous capsule, as are all the other turbinals. It descends from the entire length of the vestibule down to the floor, from which it is separated only by a narrow cleft. It is thin anteriorly, rolled up posteriorly, and presents an inferior border of bony consistency. It is a true sagittal septum dividing the vestibule

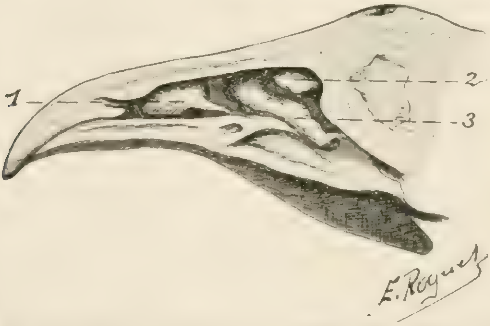

Fig. 17. Six-sevenths natural size. Turkey (Sagittal section, showing external wall and three turbinals). 1. Vestibular turbinal; 2. Superior turbinal; 3. Middle turbinal.

into two parts, an external which terminates posteriorly in a cul-de-sac, and an internal one which communicates with the nasal cavity proper.

In the duck, the vestibule communicates largely with that of the opposite side and has no turbinal. Its posterior limit is marked by an almost vertical fold of the external wall, which, narrowing the lumen at this level, forms the border of the orifice of communication between the two cavities. In the pigeon, there is a vestibular turbinal which is situated exactly under the supero-internal angle of the vestibule.

The nasal cavity proper in the turkey, duck and pigeon is narrowed by the projection of the two turbinals. They are both inserted on the external wall. The anterior turbinal, which is the middle turbinal in the turkey and in all birds which have a vestibular turbinal, has an elongated form and presents a round contour vertically and extends from before backwards and slightly from above downwards. It has an enlarged anterior extremity, and a slender posterior extremity; its free border is thick and round in the turkey, in which this turbinal has a large base of insertion (Fig. 17). In the pigeon, on the contrary, the middle turbinal is a cartilaginous lamina, slightly curled from above downwards and from within outward, with a thin pedicle and with a free border of slight thickness looking internally and inferiorly (Fig. 18).

The superior turbinal is a globular ridge placed in the neighborhood of the nasal roof and the posterior part of the cavity.

A large space, in the form of a fossa opening internally, is found between the middle turbinal and the nasal floor. A simple groove lies between the superior and the middle turbinals. Only the two turbinals of the nasal cavity proper belong to the olfactory organ. The vestibular turbinal is independent (Gegenbaur), and we have seen that in certain birds it is absent. According to Gegenbaur (1873), there is a special arrangement in the head of the bird which separates the external nasal orifice from the interior. According to what we have seen in the turkey, it has the role of dividing the vestibule into two parts, an external cul-de-sac and a very narrow internal canal; it thus protects the entrance of the nasal cavity.

The middle turbinal is the equivalent of the inferior turbinal or maxillary turbinal of mammals (Gegenbaur). This opinion is based on the insertion of this turbinal at the level of the superior maxilla and above the opening of the lachrymal canal. Its high insertion upon the external wall does not correspond to the insertion of the maxillary or inferior turbinals of mammals. It has no relation with the maxillary bone, since it is the cartilaginous capsule which supplies it, but its base is in relation with the lateral spaces which correspond to the sinus maxillaris. The superior or posterior turbinal corresponds to the first olfactory cushion of mammals. Mihalkovics homologizes it with the single turbinal of the saurians. According to Gegenbaur, there is in birds no

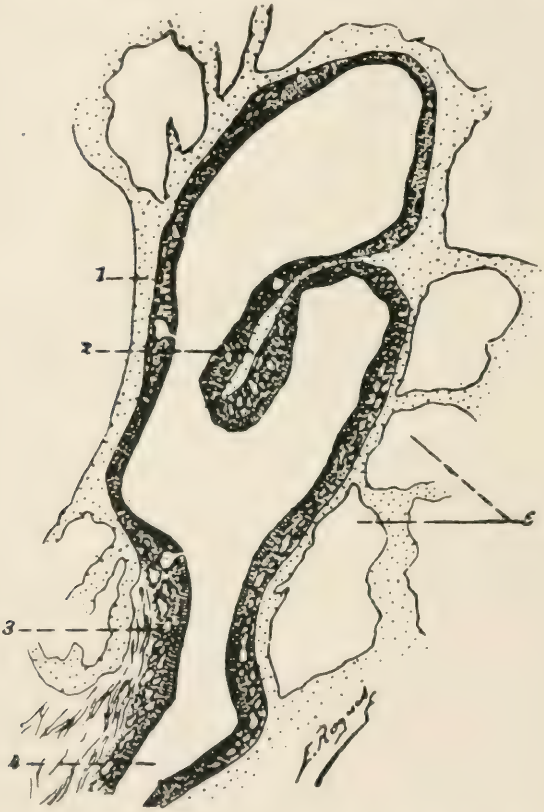

Fig. 18—X 34.3. Pigeon (transverse section of the nasal cavity, passing through the middle portion) (left side). 1. Septum; 2. Middle turbinal; 3. Chorionic glands; 4. Palatal fissure (choanal cleft); 5. Pneumatic spaces.

homologue of the ethmo-turbinal, besides, the superior turbinal is not, in his opinion, a true turbinal, and he compares it to the pseudo-turbinal of the crocodile. The superior turbinal of the vulture, through its insertion in the supero-internal angle of the nasal cavity, appears to correspond to the ethmoidal turbinal.

The nasal region is surrounded by numerous, extensive, pneumatic cavities, attaining in this respect a high degree of development. These different spaces may well be studied in transverse sections of the head of a pigeon. They are divided into two groups, an inferior and external group corresponding to the maxillary sinus, and a superior and internal corresponding to the frontal sinus.

Figure 18, representing a transverse section in the middle region of the nasal cavity, shows large lacunae external to this cavity, extending along the whole of the external wall, separated from one another by cartilaginous or fibrous septa.

They are either quadrilateral or round. Internally they are limited by the nasal capsule; externally by the fibrous tissue formed by the condensation of the deepest layers of subcutaneous connective tissue. In more anterior sections there appears a space, prolonged into the palate, limited by cartilaginous walls on all sides. This inferior space represents the palatal sinus, reported by Mihalkovics, the lateral spaces corresponding to a true sinus maxillaris. At the level of the base of the septum, below the intermaxillary and the nasal bones, the cartilaginous septum bounds a triangular space with base posterior, just where it unites with the opposite side.

At a more posterior level, this space is enlarged and is subdivided by cartilaginous lamellae. Extending posteriorly very far between the orbits, is a frontal sinus corresponding to the sinus orbitalis of Mihalkovics. The end of the septum widens into the shape of a playing-card heart, containing hollow cavities in the inferior extremity of the septal cartilage.

The direct relations between the different cavities and the nasal fossae are not visible; it shows, simply, the phenomenon of preumatisation so greatly diffused in the skeletons of birds.

NASAL SKELETON.—The cavity is surrounded above, externally and below by a cartilaginous wall which gives rise to the turbinals. It is thick and resisting, interrupted below by the palatal fissure; within, the cartilaginous capsule forms, in connection with that of the opposite side, a lamina which becomes the septal cartilage.

This cartilaginous capsule is lodged in a bony space of the facial walls, where the bones are reduced to long pieces and can constitute only an imperfect protective investment.

In the turkey, the nasal skeleton is constituted above by the intermaxillary and nasal, below by the superior maxillary and palate, externally by a part of the nasal and a part of the maxillary; internally by the septal cartilage (Fig. 19).

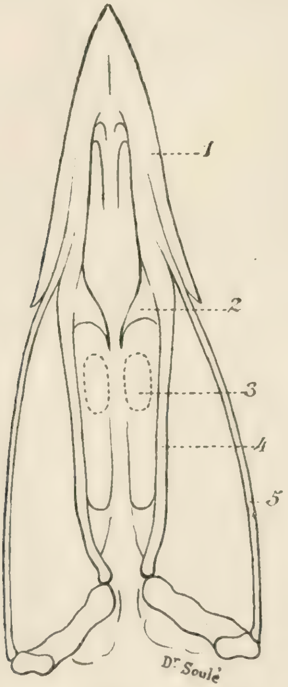

Fig. 19. Natural size. Turkey (skull seen from the inferior surface; the dotted lines indicate the position of the choana). 1. Superior maxillary; 2. Palatal process of the superior maxillary; 3. Choana in the fresh state (Schematic representation); 4. Palatal; 5. Jugal.

Intermaxillary.—Single, narrow, long bone which forms the median part of the superior surface and the point of the beak. A slight median groove indicates the division of the bone into two halves. The enlarged anterior extremity articulates with the superior maxillary, while its median part is pointed. The posterior extremity is placed btween the two nasal bones and comes in contact with the anterior border of the two frontals. The inferior surface belongs to the roof of the nasal fossae.

Maxillary.—Double complex bone of quadrilateral form. The external surface, slightly convex and smooth, is oblique from above downwards and from within outwards. The inferior surface is hollowed out by an antero-posterior fossa. The anterior extremity articulates with the intermaxillary. The posterior extremity presents three prolongations, an external portion which is continuous with the external portion of the inferior surface, a middle, very slender, which articulates with the os jugal behind, an internal one, large and flat, directed obliquely backwards and inwards, placed in a horizontal plane —the palatal prolongation.

Nasal.—Double bone, situated on each side of the intermaxillary, anterior to the frontal and internal to the lachrymal. It is large, flat and of quadrangular form; the superior surface is placed almost horizontal and is slightly hollowed out in the middle. Its inferior surface is concave transversely. The internal rectangular border articulates with the intermaxillary. The anterior concave border limits a large space filled with fibrous tissue. The posterior convex border articulates with the frontal, the external border with the lachrymal. The antero-external angle of this bone is prolonged into a long process which descends almost vertically to meet the maxillary. It constitutes the only bony part of the external nasal wall.

Palate.—Double bone, very slender, very long, passing horizontally from the posterior extremity of the maxillary to the pterygoid. The septal cartilage takes the place of the vomer. There is no bony turbinal.

In the vulture, the bones are more extensive. The anterior space between the nasal, intermaxillary and maxillary is partially filled with osseous laminae belonging to the maxillary. The palate is a large bone which forms a large part of the nasal floor. The turbinals are bony; the vestibular turbinal is a simple crochet inserted on the superior surface; the middle turbinal, inserted upon the external surface, is very voluminous, composed of the lamellae which are enlarged, perforated with numerous orifices, giving access to the air cavities; the superior turbinal, which is placed upon the most internal portion of the surface, is composed of a lamella rolled once upon itself.

In birds with a long beak, it is the anterior part of the nasal fossae, the vestibule, which is modified. The intermaxillary and maxillary bones are greatly elongated, and the nasal space which they surround is increased in length; the other bones and the principal nasal cavity do not present any essential modifications.

Parker (1869), in his study of the development of the cranium of the cock, shows the evolution, form and connections of the different bones. They are arranged in the same manner as in the turkey. The numerous figures which accompany this work are of great interest.

NASAL MUCOSA.—Throughout the vestibule and upon the vestibular turbinal, the mucosa presents a connective tissue corium and a stratified pavement epithelium having all the characteristics of epidermis, with the superficial layers strongly flattened and refractive. It is very thick over the turbinal and in the neighborhood of the external nasal orifice. The turbinal contains no cartilaginous lamina; but connective tissue and numerous vessels are present.

In the principal nasal cavity, the mucosa has the respiratory characteristics over the greatest portion of its surface; the olfactory part is limited to the nasal roof and the superior turbinal.

Over the middle turbinal is found an investment of the respiratory type, characterized by a cylindrical, ciliated epithelium and numerous depressions covered with clear cylindrical cells, as well as a great number of glands in the corium. In a section made in the middle portion of the cavity, the entire mucosa, except that of the roof, shows a considerable thickness of the chorionic layer, which contains a large number of glands. It may be said that the corium is formed by glandular tubes. They are held tightly together by one another, and the interspaces, occupied by fine connective tissue septa holding blood vessels, are very narrow. Towards the inferior border of the septum, the thickness of this glandular layer is 178 mikra. Some of these glandular tubes attain great dimensions. There are also numerous crypts, simple depressions of the epithelial surface, opening largely into the nasal cavity. Every portion of the nasal cavity possesses this richness of glands. It is most remarkable in the inferior portion of the septum and throughout the middle turbinate, with the exception of its inferior surface. The epithelial cells, which line the glandular tubes, are cylindrical and elongated. They present a base larger than the central extremity. The basal portion contains the nucleus and some strongly colored granules; it occupies almost a third of the cell. The other portion is clear, very refractive and without visible granules. In certain cul-de-sacs, the entire height of the cell presents refractive characteristics, due to the mucous glands.

Their presence gives to the mucosa a special respiratory character; the secretion must be abundant to keep moist a membrane which is subjected to very intense dryness while on flight. The epithelium of the surface is formed of high cylindrical cells, with a deep extremity containing the nucleus, intermingled with round elements, and a central extremity with finely granular and clear contents, limited towards the cavity by a granular border which is prolonged into very short cilia outside of the cell.

Glands are uncommon at the level of the nasal roof and the adjoining internal and external walls. The epithelium presents several layers of round cells lying close to one another, and a superficial layer of cylindrical cells. Max Schultze describes olfactory cells in birds, analogous to those in amphibia and reptiles, possessing tufts of long cilia and cylindrical nonciliated epithelial cells.

In the air cavities we have not found a mucous investment covering the cartilaginous or fibrous walls.

Besides the numerous glands included in the corium of the respiratory mucosa, there are glandular masses in the neighborhood of the nasal cavity.

In the vestibular region, a group of cul-de-sacs is found between the two cavities, near the buccal roof, which are glands belonging to the buccal cavity.

Towards the anterior extremity of the principal cavity, glandular tubes are seen, on transverse section, placed some above and some below the palatal and maxillary sinues. The inferior group continues posteriorly along the external lip of the palatal fissure. The superior group (external nasal gland), which increases in importance at a more posterior level, is placed opposite the line of insertion of the middle turbinal, then disappears at about its middle portion. Some glandular tubes are found in the posterior region, external to the frontal sinus above the nasal roof.

These glands have a deep cubical epithelium, with a nucleus in the middle portion of the cell, with a clear, finely granular zone within. They are serous in character.

Most birds possess a special glandular apparatus, studied by Cuvier, Tiedemann and Jacobson. Nistch describes it under the name of nasal gland. Jobert (1869) made a very complete study of it in 1869. He made observations on the waders and the palmipeds. The gland is located in a hollow fossa in the frontal which limits it posteriorly and laterally, while the lachrymal bounds it anteriorly. The excretory duct discovered by Jacobson, then by Nistch, is double according to Jobert. The two excretory ducts, formed of long, laminated fibres, are directed from above downwards and from behind forwards; the superior passes under the nasal bone and opens at the superior and external portion of the nose. The other, deflected, descends behind the nasal and opens on the internal surface of the nose in the middle meatus.

According to Müller, all the glands of the nose have the same structure as the salivary glands. Jobert accepts this view for the nasal gland.

This gland has been considered by Cuvier and Nistch as a lachrymal gland; acording to Tiedemann, it secretes an oily liquid and it is on this account well developed in birds which live in the water or on the shore.

No glands below the corium are found in the interior of the septum. It contains only connective tissue and the vessels of each side of the cartilaginous axis. There is no trace, in the pigeon, of invagination of the mucosa, nor of an isolated tube which might represent an organ of Jacobson. Ganin and Mihalkovics have described an invagination of the mucosa in the septum at the level of the anterior extremity of the middle turbinal which, in certain transverse sections, is isolated and closed in the form of a tube. According to their view this represents an organ of Jacobson. Mihalkovics compares this formation with the canal of Jacobson in the human fetus. There is evidently a great resemblance between them.

Birds form an aberrant group between saurians and mammals which possess a well-developed organ of Jacobson. The absence of the organ coincides, in these, with a greatly reduced olfactory sense. Whether or not this organ has the function of exercising a sensory control upon the contents of the buccal cavity, it is found largely replaced by olfactory epithelium itself, which is directly affected by virtue of the communication established between the buccal and nasal cavities by the long palatal fissure.

(*To be continued in the June number.*)

II.

REMARKS ON THE MACROSCOPIC DIAGNOSIS AND GENERAL INDICATIONS FOR TREATMENT OF CANCER OF THE LARYNX.*

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There is no chapter in the book of laryngology that needs more careful revision than the chapter on cancer of the upper air passages. Indeed, it will have to be entirely rewritten. We are passing through a crisis in the history of this subject in which the same old battle is being fought that has raged around every other organ of the body where cancer dwells. Here, as elsewhere, we have much to learn, much to unlearn.

In responding to your courteous invitation to take part in this symposium I think I can perhaps best utilize the limited time (twenty minutes) which has been placed at my disposal by calling attention as briefly as possible to two phases of the problem of cancer in the larynx, which, in view of the unsettled state of the question, seem to me of most pressing and immediate importance.

In the present state of our knowledge there are three principal methods of diagnosis in laryngeal cancer. These are, in the order of their practical usefulness and importance: 1. The naked-eye method, or diagnosis by direct inspection, supplemented by clinical phenomena. 2. Thyrotomy. 3. The microscope. Of the three methods the second is often included in, and therefore ancillary to, the first. Take it all in all, the first method is by far the most practicable and satisfactory of the three. I shall consider briefly only one of its different phases.

For some time past, inspired by the work in the surgical department of the Johns Hopkins Hospital and guided by my own personal observation in the matter, I have become more and more impressed with the possibilities of naked-eye inspection, or macroscopic diagnosis, in malignant disease of the upper air passages. Although for a long time entertaining strong convictions on the subject, I first gave definite and public expression to them in some remarks made at the opening of the debate on "Cancer of the Larynx" at the Congress of the American Laryngological Association held in the city of Washington in 1900. My object then, as it is now, was to stimulate study in the direction of the macroscopic diagnosis and pathology of laryngeal growths, and the examination of the fresh specimen or material with the naked eye.

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*Remarks made in a Symposium on Cancer, held at the New York Academy of Medicine, October 19, 1905, at the Twenty-second Annual Meeting of the New York State Medical Association.

Much has already been accomplished by this method in the field of advanced surgical pathology, so that the general surgeon is to-day coming less and less to rely upon the pure pathologist for diagnosis, and to seek the aid of the microscope, except as a court of the very last resort. To use the words of Bloodgood, who has done most excellent and painstaking work in this field, the surgeon must, in the majority of cases, make the correct diagnosis of tumors, "not on the clinical history and examination, but in all those cases which are not clinically positive, he must base his diagnosis on the naked-eye appearance of the diseased tissue, exposed by the knife at the exploratory operation."[1] This observer, in a careful analysis of over 1300 cases of tumor in Halsted's clinic at the Johns Hopkins Hospital (in which the benign stood to the malignant in the proporition of 1 to 3), comes to the conclusion that it is possible, in the majority of cases, to recognize the character of the growth by the naked-eye appearance alone. From this study, also, it is shown that it is not only possible, as a rule, to differentiate the benign tumors from the malignant at the exploratory incision, but to recognize in the malignant the different groups of varying malignancy, and in the benign, growths which have a tendency to become malignant.

In Halsted's clinic at the Johns Hopkins Hospital more reliance is placed on the naked-eye diagnosis than on the frozen section. It is claimed that even with the use of recent improved methods of preparing the latter, the naked-eye method furnishes more accurate diagnostic information; and although the frozen section undoubtedly holds its own as a most valuable means of diagnosis, still it is often misleading and more con-

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(1) International Clinics, 1904, fourteenth series, vol. i, p. 237.

fusing than the macroscopic image of the cut surface.

It is difficult, if not impossible, to satisfactorily depict the macroscopic appearances of tumors by means of language. A's description would be perfectly unintelligible to B, B's account would have little or no meaning for C, while C's picture would be utterly bewildering to D — and so on to the end of the alphabet. I cannot possibly emphasize this point better than by quoting the words of Halsted in his illuminating address on the "Training of the Surgeon," delivered last year at Yale.[1] "I am sure that much of the material for surgical pathology can be correctly described only when it is perfectly fresh. It cannot be painted, because in less than a minute, in a few seconds often, the appearance of a freshly cut surface is greatly changed. Only those who are well trained as macroscopic pathologists, who have naturally a discriminating eye for color, a good sense for form, and some talent for expression can properly describe the fresh material. Many, if not most, of the descriptions are worthless or at best serve only as reminders to those who can distinctly recall the case. The descriptions, by two trained men, of ordinary fresh material may differ so greatly, that one could not believe they pertained to the same specimen. Color photography might be employed, it seems to me, with great benefit, for recording the appearance of fresh specimens."

I cannot insist too strongly on the application of the naked-eye method of diagnosis in the case of malignant tumors of the larynx. Every resource and refinement of clinical diagnosis, including the exclusion of syphilis by the iodides and tuberculosis by tuberculin, should be resorted to before an appeal to the microscope is made. By following the lead of the general surgeon, with the means of clinical diagnosis already at our command, together with more exact information concerning the naked-eye appearances of the cut surface of laryngeal neoplasms, we will soon be in a position where we will be more and more independent of the pure pathologist for help in diagnosis.

Every tumor of the larynx, no matter how benign it may appear, should be examined with the greatest possible care. Some of the most fatal diseases known to man make their first appearance in the larynx in the guise of great benignity. Thus the presence of cancer and tuberculosis in the individual is often first proclaimed by the discovery of an apparently simple papil-

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(1) Bulletin of the Johns Hopkins Hospital, Sept., 1904.

lomatous excrescence in the larynx. By the careful study of *every* case coming under our observation, we will some day, among other things, clear up the mystery which surrounds the genesis of papilloma and approach more closely the earliest possible recognition of some of the most deadly diseases of the larynx.

This brings me to the consideration of the question of the partial extirpation of laryngeal cancer for microscopic diagnosis.

The objections which I have repeatedly urged against the indiscriminate removal of tissue for examination (especially when done through the natural passages) are as follows: 1. It subjects the patient to the danger of antoinfection at the point of incision and to metastasis elsewhere. 2. It stimulates the local growth of the cancer. 3. Finally, the method is often inconclusive, misleading, and sometimes practically impossible.

The moment the continuity of the growth is broken, in that moment is opened the pathway for self-poisoning, and an unfavorable influence is excited on the local process. If ulceration has already taken place, a portion of the growth can be taken, if skilfully removed, for microscopic examination; but, as Bloodgood has pointed out, in the majority of cases the tumor is "buried" and an exploratory incision for purposes of microscopic diagnosis means two operations, and if the tumor is malignant, opens the way for general dissemination.

If I interpret aright the general sentiment of those laryngologists who are qualified to speak with authority on the subject, and who have declared themselves on this phase of the question, it is practically to the effect that attempts at incomplete removal (whether for diagnostic or curative purposes) of malignant growths of the larynx have little or no irritating or stimulating effect upon the local disease. In view of the established and glaring fact that the growth of cancer elsewhere in the body is stirred into greater activity by incautious manipulation of the local lesion, it seems well nigh incredible that any disagreement of opinion in the matter should exist in the case of cancer of the larynx. And yet, strange as it may seem from the standpoint of the modern conception of cancer, the universal sentiment of authority is to-day practically unanimous in advising indiscriminate and immediate removal of portions of a suspected laryngeal neoplasm as an early and routine means of diagnosis. Even the best of laryngeal surgeons lose no time in procuring pieces of a supposed cancerous growth of the larynx for examination under the microscope, before they have gone carefully into the history of the case and endeavored to make the diagnosis with the naked eye alone. In the light of my own experience, I do not hesitate to declare that cancer in the larynx behaves in precisely the same way under incautious irritation or manipulation as it does in other organs of the body. Not to multiply examples, I well remember the method of treatment of laryngeal cancer in my earlier days (at the Golden Square Hospital, London), which consisted in the performance of tracheotomy and the subsequent removal, piecemeal, of the growth through the natural passages. By this process, which to-day in enlightened surgical communities would be considered as a means of slow murder, the growth was stimulated at once into much greater activity, the patient naturally became worse and worse, and was sent to his long home much earlier than if he had been left severely alone. As I have said on another occasion, when I look back through the years in which I have seen cancer of the larynx maltreated, and in which I have unconsciously maltreated it myself, I am simply appalled at the retrospection.

I am sorry, too, that my personal experience does not agree with that of some of my laryngological friends who deny the possible dangers of autoinoculation and metastasis after incomplete attempts at the removal of laryngeal cancer. The position, it seems to me, is axiomatic and does not call for debate. If all the cases of metastases following incautious operations on laryngeal cancer were to be placed on record, their number would appear in the form of a revelation. Such cases do not usually find their way into print.

And just here let me say if any one wishes to know in what sense I use the term metastasis, let him consult the nearest medical dictionary for a definition of the term. To charge, at least by innuendo, as one of my critics has done, that by "metastasis" I mean the inhalation into the lungs or the deglutition into the stomach of detached fragments of the growth is simply unmitigated nonsense.

As to the question of direct inoculation of the laryngeal tissue by constant contact of opposing broken or unbroken surfaces, I can only say that, while not denying the possibility of its existence in cases in which the foul discharge from the cancerous mass may come in contact with an abraded or ulcerated surface, I have never met with an authenticated case of the kind in literature, nor have I ever seen this accident in practice. Such a phenomenon is common and characteristic and of important diagnostic significance in tuberculosis; in cancer of the larynx, its occurrence is as yet unknown and problematical. To confound such a phenomenon with the phenomenon of metastasis, however, with which it has nothing in common and to which it bears no resemblance, would be an inconceivable blunder had it not already been committed.

An interesting fact in connection with this part of the subject is the great difference in the tendency to metastasis after cauterization and after incision of cancerous tissue. In the former (when done, for example, by fire or escharotic), while metastasis may and does occur, there seems to be only a slight tendency to dissemination, while on the other hand, when the knife is used, metastasis is almost sure to follow. Thus, out of hundreds of cases of breast cancer in Halsted's clinic, not a solitary patient has been cured in whom the tumor had been previously incised or operated upon by surgeons outside of the hospital. There have been several in which a cure has been effected after recurrence, the original operation having been done in the hospital, but not a single case of cure in which the patient was operated on before entering the institution.

I need not dilate upon the difficulties in the way of the microscopic diagnosis of cancer of the larynx. They are multitudinous. That the very best pathologists make mistakes (especially in the diagnosis of tumors) is a matter of common observation. The surgeon, through no fault of his (and even the pathologist), may be easily misled and therefore only such testimony should be accepted as final as comes from an expert specially versed in the histological differentiation of tumors.

In closing this part of my subject, permit me to correct a wrong impression that seems to have been created in the minds of some of my colleagues both at home and abroad as to my views on microscopic evidence in the diagnosis of suspicious looking neoplasms of the larynx. According to my critics, I reject completely the use of the microscopic in the diagnosis of malignant growths of the larynx, and therefore would recommend the complete operation for that disease in the presence of doubt as to its nature. As one of them puts it, I "kick the microscope into the dust heap." No one but a congenital fool would refuse in doubtful cases the aid of the microscope, and no one outside of the asylum would advise a radical operation (such as the one suggested by me) without a certainty of diagnosis. There are some things that go without saying and which ought to be obvious to the dullest apprehension, and I cannot think that any one who knows me can believe me guilty of such insanity. My original remarks made in 1900, which have called forth such a storm of abuse and misrepresentation, dealt in general principles of diagnosis, and no attempt at elaboration or specification was made. My position, as then stated, is simply that the microscope should be the court of last resort — the final method of appeal. Hands off the growth until the last. Then, if microscopic examination is necessary, let patient and surgeon be prepared for immediate operation. As I said on the occasion already referred to, "before resorting to thyrotomy in general, especially if a portion of the growth is to be removed for examination, it should be clearly understood beforehand with the patient that, if the disease should prove to be cancerous, the surgeon shall be at liberty, if in his judgment it seems best, to proceed at once to operation." I took this stand in order to check, if possible, the reckless and indiscriminate removal by laryngologists of suspected tumors of the larynx for microscopic examination, and from what I hear and read I may be pardoned if I say that the warning has not been given in vain.

What the future has in store for the treatment of cancer can only be a matter of conjecture. Serum therapy will doubtless some day play a conspicuous part in the treatment of this disease. For surgical treatment to be sufficiently radical involves the sacrifice of so much tissue that the time must surely come when surgery will be supplanted by simpler and more certain means; and with the discovery of the agent of infection will come its antidote. But with the possible future discovery of a serum, with perhaps the ultimate development of the fact that cancer is due to chemical changes in the blood, and therefore beyond the reach and uninfluenced by surgical procedure—with these and other possibilities we are not as yet confronted. The knife is our only weapon today. How can we best employ it?

I do not propose, nor have I the time, to go into any unprofitable discussion of the relative merits of the various operations done for laryngeal cancer, but will simply ask attention in a general way to the chief indications for and the nature of the operation to be performed for that disease. The indications for operation may be conveniently considered under three principal heads, viz.: (1) the size, (2) the situation and extent, and finally (3) the character of the growth.

1. *Character.* Of these, the latter is by far the most important, and its discussion brings us to the consideration of an immensely important phase of the question, viz., the possibility that the rapidity and certainty of metastasis in laryngeal cancer probably depends not so much upon the situation or even size of the growth as upon its character. In other parts of the organism, some forms of cancer, as is well known, tend to form metastasis quicker than others; in other forms metastasis takes place at a much later period. Examples of the first class are the "spined-cell" tumors, and of the second the group of basal-cell growths. It is very possible that this is true in regard to tumors of the larynx, and that there are in this organ forms of carcinoma of varying degrees of malignancy and with marked difference in their tendency to metastasis. If, then, in the future evolution of our special knowledge along these lines, it shall be indisputably shown, by specially directed study and observation, that some laryngeal cancers are clinically more malignant than others, and that, on the other hand, there are some hitherto thought to be specially malignant which for all surgical purposes are practically benign; then in considering the indication for and character of the operation to be performed, the two conditions of size and situation of the neoplasm become matters of relatively secondary importance.

2. *Size.* A specially malignant type of growth (such as, for example, a scirrhous or medullary cancer), no matter what its size or appearance, no matter whether it is situated inside the larynx or outside the larynx, would demand the most drastic surgical procedure, while in the case of a less malignant and dangerous tumor (as for example the basal-cell cancer) a less radical operation might possibly be called for.

Laryngologists have heretofore committed the common error of grouping together in one class all malignant and quasimalignant laryngeal growths, without making those finer histological distinctions which are so necessary to the proper conception of the relative malignancy of the tumor and the manner of its removal. This finer anatomical differentiation of malignant larynx tumors is a fertile field for future laryngological study and research. The uncertain or quasimalignancy of some tumors may possibly furnish the explanation of non-recurrence after incomplete removal of the laryngeal structures.

3. *Situation.* I do not believe that any other than the most radical operation should be undertaken in cases in which the disease is medianly situated (as for example, at the anterior commissure or on the posterior wall of the larynx), or in which it occupies both sides of the larynx, or in which, being unilaterally situated, it approaches at all closely the middle line. Equally hazardous would be an incomplete operation in cases in which the disease appears as a diffuse infiltration, especially if fixation has occurred (no matter where situated or to what extent the larynx is visibly involved).

I may say, in passing, that whatever may be thought of other incomplete operations for the cure of laryngeal cancer, there are two methods of procedure which in future narratives of this disorder will be referred to as matters of purely historical interest — the operation through the natural passages and subhyoid pharyngotomy.

It is amazing what a hold the intralaryngeal operation still retains on the minds of some of the world's best laryngologists. It is a curious fact that the practice of removing malignant neoplasms of the larynx through the mouth obtains in intelligent quarters even at the present day. And yet the operators who resort to it are simply following the lead of some of the most prominent laryngologists all over the civilized globe. High authority not only sanctions but adopts it as an unquestioned method of treatment. Even in Germany it still has its supporters. The author of the chapter on malignant growths of the larynx, in Heymann's *Handbook*, not only advocates it, but also recommends (at least in the early stages of cancer) the endolaryngeal method, devoting seven pages to its consideration and only two to the more radical measures. While I am quite willing to admire and applaud the skill with which some of these operations are performed, nevertheless, for reasons which I have repeatedly given elsewhere, I cannot too emphatically condemn such a method of procedure. No amount of skilful endolaryngeal manipulation should justify or palliate such an uncertain and perilous operation, especially (for obvious reasons) when the growth is situated in the infraglottic region. Removal of cancer of the larynx by the endolaryngeal method, therefore, should never come within the range of serious consideration. The risks, even in the earliest cases, are too many and too great. It is a dangerous game in which both surgeon and patient take the gambler's chance.

The same thing may be said of subhyoid pharyngotomy. The number of cases in which it would be even indicated is excessively small, while the risks of the operation far outweigh any advantage to be gained by its performance.

In approaching the treatment of laryngeal cancer we have to face the following facts:

1. It is impossible to limit the extent of the disease laryngoscopically.

2. It is often equally impossible, even after preliminary division of the thyroid, to map out with certainty the whole area occupied by the disease. This is especially true in the case of diffuse infiltration, or where the epithelioma originates in the deep-seated tissues and does not approach the surface until a late stage of the disease.

The loose tissue beneath the mucous membrane in many places, and its wealth in lymphatics, often favor, from a small focus of infection, infiltration of and crossing to other portions of the larynx, and sometimes with great rapidity. Diffuse infiltration, especially if there be fixation of the parts, even though confined to a small area, should always awaken suspicion of the existence of the disease elsewhere in the organ, even though no apparent signs of its presence exist.

3. Even after the removal of the entire larynx, the disease may be apparent in one side of the organ and not in the other, and yet the microscope show extensive carcinomatous deposit in the seemingly normal side. We can never be sure, even in cases in which the cancer appears to be distinctly circumscribed, whether dissemmination in other parts of the larynx has not taken place.

4. Cancer in the larynx grows with greater rapidity than it does in other regions of the body. This is due not alone to the histological structure of the organ, but also, and chiefly, to the fact that its physiological mechanism is in ceaseless operation.

5. Investigations, in the study of cancer in other parts of the body, have developed the fact that the amount of lymphatic involvement bears no definite relation to the size and extent of the local lesion. Thus, a small local focus of infection may

be attended with most extensive metastasis to the glandular adnexa; while, on the other hand, the latter may not be markedly involved even in extensive invasion of the primary disease. One or two illustrations will suffice. It has been shown, for example (Wertheim,[1] Sampson[2]), that in the case of cancer of the uterus, there is no relation between the size of the primary growth and the presence or absence of involvement of the pelvic lymphatic glands, and that we can never, therefore, tell clinically whether or not metastasis has taken place. And to come nearer to our subject, a notable example of the disproportion between the size and extent of the local lesion and the lymphatic involvement is furnished in the case of the lip. Not infrequently cases are brought to the surgical clinic, in which masses of enormously enlarged neck glands have been removed under the impression that the condition was the original disease, when, as a matter of fact, a small unnoticed inconspicuous abrasion or ulcer of the lip has been the primary focus of infection.

These are facts not only of great practical prognostic significance, but also, if shown to apply to the larynx and its lymphatic supply, of overwhelming importance in the surgical treatment of cancer occurring in that organ. It will be the task of the future to determine whether in more or less advanced stages of this affection, or even in its earlier history, the disease may not already lurk in the neighboring lymphatics, as has been demonstrated in the case of cancer elsewhere in the body.

In practically all fatal cases of larynx cancer, death is due to metastasis. In neighboring organs (the neck and mouth) metastasis takes place with great certainty and at an early date. It is therefore, *a priori,* probable that the neck glands are affected in the case of cancer of the larynx, although perhaps not recognizable by the senses of sight and touch, at a much earlier period than is generally supposed. It is at all events safer to assume this to be the fact than to accept the statement, unsupported by definite anatomical proof, that cancer in the interior of the larynx remains for a more or less indefinite period as a purely localized disease, and does not get into the neck lymphatics until a late stage of the affection.

This is a fundamentally important phase of the question

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(1) Archiv. f. Gynäkologie, 1900. Bd. lxi. No. 3.

(2) Journal of the American Medical Association. October 29, 1904; Albany Medical Annals, May, 1905, etc.

upon which as yet little or no light has been shed. Until more exact knowledge concerning it be forthcoming, it behooves the surgeon to move with caution, even in cases in which the disease is apparently a distinctly localized affection. In the presence, therefore, of the fact that it is often impossible to limit the diseased area by inspection and the sense of touch, and in the light of the revelations of the microscope, it becomes a serious question whether we accomplish any lasting good, in the majority of cases at least, by any operation short of complete excision of the larynx and the neighboring lymphatics and glands.

On this subject, however, there is much honest difference of opinion. I am not here to discuss it. The whole question, as I have tried to indicate, resolves itself into two special lines of study, viz.: (1) the relative malignancy of tumors of the larynx, and (2) the determination of the glandular involvement in the case of various kinds of tumors as well as various situations of tumors. Investigation along these lines must determine largely the manner of future operative procedure. Whatever operation is done, it should be forever borne in mind that we are dealing with cancer; that no matter how minute the original lesion may be, the area of possible poisoning is practically boundless; and that if the slightest doubt exists as to the character and circumscription of the growth, the complete operation should be done.

Let us finally look forward to the day, which in my humble judgment has not yet arrived, when it shall be definitely shown beyond all human doubt that cancer of the larynx, taken in its earliest stages, while yet a purely localized affection, can be permanently cured by simple surgical measures; but in the meantime, in the present state of our knowledge at least, in view of the uncertainties which the problem before us presents, and in the light of the modern conception of the treatment of cancer, let the surgeon be prepared to take no chances, but in the forceful, if inelegant words of Gross, let him "cut out the very atmosphere of the damned thing."

III.

THE TREATMENT OF HYPERTROPHIC AND INTUMESCENT RHINITIS.*

PRELIMINARY REPORT.

By E. Fletcher Ingals, M. D., and Stanton A. Friedberg, M. D.,

CHICAGO.

The treatment of chronic rhinitis of the hypertrophic and intumescent forms is a subject that has been frequently discussed. Nevertheless, it possesses sufficient interest to warrant one in making a clinical study of a definite number of cases in order to ascertain just what results have been obtained from a particular line of treatment. A detailed study of the results of cauterization with the galvano-cautery in these cases has only confirmed us in the belief that this operation, when properly performed, offers the most satisfactory method in the treatment of these conditions.

The use of the galvano-cautery in the treatment of the ordinary forms of so-called nasal catarrh, has to some degree given way to the snare, scissors, or the local application of medical agents. Some rhinologists have condemned it on account of a supposed liability in causing ear complications. For various additional reasons, others have laid it aside. Probably some of the same factors that entered into bringing into disrepute chemical cauterizations, have affected similarly galvano-cauterizations, although a comparison of the two methods, in our opinion, shows that the latter is more easily controlled and produces more lasting results, without destroying large areas of mucous membrane. Not only can a greater length of the turbinal body be safely cauterized at one sitting, but the cauterization can be made deeper and more effective and can be accurately limited to the region desired. The snare and scissors without question have their place in the treatment of these nasal conditions, but the indication for their use is less frequent. Naturally where the hypertrophy is of great extent or confined to the posterior ends of the turbinals, these would be the instruments of selection. In the intumescent forms of the disease, the galvano-cautery is superior, as it destroys only a small part of the turbinal tissue, and as the wound heals a contraction down to the bone is brought about which prevents subsequent swelling. It is easy to remove too much tissue and bring on an apparent atrophic condition, as may be done with a too free use of the snare. The use of local remedies, such as astringents, while sometimes affording temporary relief, have not impressed us with the permanancy of their results.

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*Read at the Middle Section of the American Larnygological, Rhinological and Otological Society, Feb. 24, 1906.

In order to show the value of the galvano-cautery, in the usual cases of catarrh, one hundred consecutive records, in which treatment had been carried sufficiently far to serve as a basis for comparison, were taken, comprising fifty of the hypertrophic form and fifty of the intumescent. The records were of patients, the majority of whom were first seen from three to five years ago. This was done in order to be sure that sufficient time had elapsed from the beginning and end of treatment to obviate any doubt as to the permanancy of the results. No case in which there had been less than two cauterizations was taken, although not infrequently patients experience relief from one operation, yet many for various reasons do not return for further treatment.

In a careful study of the 100 cases, the causes of complaint were found to be exceedingly variable, but in the main, the symptoms for which treatment was instituted ranged from a feeling of stuffiness in the nose, stopping up or occlusion of one side alternately with the other, or of both sides at the same time, to permanent obstruction complete or incomplete of one or both sides. Along with these conditions were sensations of dryness in the nose, pain usually referred to the root of the nose, dropping back of mucus into the nasopharynx, or excess of secretion in the nose without any discoverable indication of sinus disease. Headaches, impairment of the sense of smell, sneezing and a history of catching cold easily were also noted as troublesome symptoms. Gastro-intestinal disturbances were present in some instances. Some also presented certain symptoms referable to an associated catarrhal condition of the ears, such as a sense of fullness, tinnitus and more or less loss of hearing. Symptoms of pharyngitis or laryngitis were noted in a considerable number of cases, due to a transient or persistent habit of mouth-breathing.

The duration of the nasal affection was variously stated. Some patients give a history of having been troubled always, the shortest time was three weeks. The greater number had been affected from one to six years.

The nasal conditions for which cauterizations were undertaken have varied from an obstruction of approximately one-fourth the lumen of the naris to complete closure of the same, embracing, of course, the simple intumescent or intermittent forms and those of the chronic or hypertrophic form, circumscribed or general, with partial or complete permanent obstruction. In many instances definite statements were given by the patients as to the ability or inability to breathe freely through the nose, in whom at the time of the examination the reverse conditions were present.

In a number of cases, exostoses of greater or less degree were present, necessitating removal before an entirely satisfactory result could be obtained; but in the majority, the results were satisfactory without any septal operation. We never recommend this operation unless sure that the condition of the septum causes decided obstruction to nasal respiration. Where the hypertrophy of the posterior end of the turbinal body was great, the snare was employed.

In the hypertrophic form one or the other side was free at the first examination in fourteen cases. Swelling was found on only one side in twelve instances, but both sides were involved in 33 of this series.

In the intumescent form, at the first examination, one or the other side was free in 18 and both sides in 3 cases. Swelling was present on only one side in 28 and in both nares in 15 of the patients.

The inferior turbinal bones were enlarged in two, and the posterior ends of the turbinal bodies were considerably enlarged in four cases.

Exostoses of the septum were noted in one or the other side in the hypertrophic form in 20 cases. Swelling of the septum occurred in both sides three times and in either side alone, eight times. Simple deflection was found in one case and deflection and exostoses in four.

In the intumescent form exostoses were present in one side 19 times and in both sides 3 times. Swelling of the septum occurred on both sides 3 times, in one side 3 times. Deflection occurred twice and deflection and exostosis the same number of times. Out of the 100 cases the septum was involved in 51, exclusive of those in which merely swelling was noted. Adhesions and perforation were each found once.

The middle turbinal showed changes such as hypertrophy, swelling or polypoid degeneration in only 17 instances and these changes were confined to one side. Polypi were found in five cases. Submucous thickening at the sides and base of the vomer was noted six times. Hyperesthesia was found three times and in four cases the mucous membrane was noted as paler than normal.

METHOD OF CAUTERIZATION.

The first step in preparing the naris for cauterization is the removal of any secretion that may be present, after which the turbinal body is anesthetised with a four per cent solution of cocain, containing in addition, the following ingredients: Atropin gr. 1-10, strophanthin gr. 1-5, ol. caryophyli M. iii, acid carbolic grs. x to aqua dest. oz. 1 and methylene blue, sufficient to color the solution a light blue. This solution is applied by means of a cotton-wound flat applicator which is slowly rubbed backward and forward along the entire length of the turbinal, for from 20 to 30 seconds. From three to five such applications are ordinarily necessary to complete the anesthesia. In a few instances where a 4 per cent solution is not strong enough to produce anesthesia, a stronger solution must be used. Constitutional symptoms from the use of this 4 per cent solution are extremely rare. Where a patient has an idiosyncrasy to cocain, eucain or alypin is used.

The knife-like electrode is introduced and a linear cauterization is made extending the whole length of the inferior turbinate body, usually at the junction of the upper with the middle third, or of the middle with the lower third of the body. In an occasional case where the reaction from the cauterization has been too great, only one-third or one-half of a complete line is made at subsequent sittings. Following the cauterization an application of compound tincture of benzoin with an excess of two ounces of benzoin to each ounce of powder of iodol is applied to the burnt line, followed by a mild oily spray. This seems to lessen the chance of infection and also lessens the reaction from cauterization. The patient is given an oily spray and a powder for home use and is directed to wear a pledget of cotton in the nostrils when out of doors for four or five days. He is told to return at the end of this time and a probe is passed between the turbinal body and septum in order to prevent an adhesion taking place. If everything is going well, he is then told to return in from ten days to two weeks, when another cauterization will be made upon the opposite side. Much discomfort is apt to be caused if a second cauterization is made before at least ten or twelve days have elapsed. In this time the nose, while not entirely healed, has recovered sufficiently to permit of a second operation.

In cauterizing the middle turbinal or septum, only short lines are made each time.

Altogether 295 cauterizations were made, 149 in the hypertrophic and 146 in the intumescent variety. The right inferior turbinal was cauterized 137 times, the left 143, the right side of the septum 12, the left once, and the right middle turbinal only two times.

It was necessary in 25 of the cases to perform other operations; which were 27 in number, viz., exostosis removed in 11, polypi in 4, adhesions cut in 2, resection of septum in 2, burr or trephine through turbinal bone in 5 cases, posterior ends snared off in 3 and tonsils removed in 1; of these 25 cases, nine had undergone some previous operation. In addition to these nine, ten more cases of the series had been operated previously. These operations consisted of removal of tonsils in five, of Luschka's tonsils in three, cauterizations in nine, removal of polypi in three, resection of septum in one, removal of spur in one and of part of turbinal in one. Several of these operations were combined in some of the cases.

Of complications or unfavorable conditions following the operation, bleeding was noted in seven instances. In no one of these cases, however, was it of any great importance, as it was not necessary to adopt any measures such as packing to stop the flow of blood. Attention is called to this merely to show that if sufficient care is used in having the electrode at the proper heat, bleeding can practically always be prevented. Only in those cases in which the wire is at too white a heat is there liable to be any trouble from this source. Adhesions were noted in five cases, but they were usually readily broken down by the use of a probe; this was sometimes followed by the application of a mild solution of silver nitrate.

When caution is used to avoid wounding the mucous membrane of the septum opposite to the point of cauterization and when the patient is seen again in four or five days, the liability to adhesion-formation is greatly diminished.

The use of a spray in the home treatment caused some trouble in seven instances. These patients complained of soreness of the nostril, sneezing, dryness, increased discharge or nausea. Headache, pain in the nose, or neuralgia, were complained of in a few cases following the cauterization. Several of these patients, on returning, spoke of having caught cold with the attendant symptoms of an acute rhinitis, a condition that should be anticipated after most intranasal operations. Tonsillitis occurred within one day after the cauterization in one case. Increased secretion was noted a few times, as was also a feeling of dryness in the nose. In one case the burnt area healed very slowly. Complete healing of the catarrhal condition, as a rule, takes place in from four to six weeks after the cauterizations have been completed, and after this time there is but rarely any complaint as to dryness, crusting or scabbing in the nose.

In no instance was there any aural disturbance or complication attributable to the cauterization, although we have observed such a complication in one instance in several thousand operations.

The shortest period of treatment was eight days; the longest was for two years. However, in this latter case the treatment was frequently interrupted for months at a time. Fourteen were treated for less than twenty-four days, sixty-three were treated for from one to six months, seventeen from this time up to one year, and seven over a year. However, it should be stated that in a considerable number of cases in which the treatment was prolonged, the patients were from out of the city and consequently the treatment was not continuous, it being largely a matter of convenience to the patient when he would return. Of the sixty-three who were under treatment from one to six months, the greater part were under care from one to three months. The average number of consultations in this latter division was about six.

In the average uncomplicated cases of hypertrophic or intumescent rhinitis, eight to ten weeks, with six to ten consultations all told, should be sufficient to effect a cure. Relief, however, may be obtained in less time, most patients noticing this in but a few days after the first cauterization.

The time elapsing between cauterizations varied greatly; this extended from eight days to 13½ months. No case was cauterized the second time before eight days had elapsed since the previous cauterization. The second cauterization was not made until after an interval of three months in sixteen cases. The greater majority of succeeding cauterizations were noted in from eight days to one month. More cauterizations took place after a lapse of fourteen days, than upon the lapse of any other period of time.

A second cauterization is rarely made before ten days have passed since the former one and it is only made then when some special exigency requires. Experience has shown that it is better to wait about fourteen days before undertaking another operation. While the nose is not entirely healed even at this time, it has so far recovered as not to cause the patient any serious inconvenience because the succeeding operation is made in the opposite naris. In some instances, especially when the general health is not up to the normal standard and when consequently the wound heals slowly, it is better to wait a longer time.

The results of treatment in the hypertrophic form of rhinitis were, in eighteen cases, excellent, improved in nineteen, partial improvement in seven, not improved in one, and no information obtained in five. In the intumescent form the results were excellent in twenty-seven, improvement in thirteen, partial improvement in three, no improvement in one and not stated in six. It is only fair to state that in most of the cases in which the results are given as not improved or partially improved, the treatment was unfinished. In like manner, with those in whom no statement of condition was found in the records, it is reasonably certain that the majority of them obtained relief.

Adding the results obtained in both series, we have seventy-seven cases in which the results were excellent or much benefited, ten in which partial improvement was found, two in which there was not improvement and eleven cases in which there was no statement as to improvement or lack of improvement, and of these eleven, in eight, the treatment was of less than one month's duration and was unfinished.

In is interesting to note that three cases of asthma were found in this list which were treated locally and with internal remedies. The asthma, although the nasal trouble was relieved, failed to improve in two. In one case, with the improvement in the nose, relief was secured from the asthma. Mouth-breathing persisted in two cases, although the nose was freed of obstruction. This was probably due largely to force of habit.

CONCLUSIONS.

1. The galvano-cautery when properly used offers one of the best, if not the best, methods for the treatment of the intumescent and hypertrophic form of rhinitis.

2. The dangers of middle-ear infection have been greatly exaggerated, not any case in the series and only one among several thousand cauterizations, having come under our observation.

3. The liability to adhesion-formation is not great, providing sufficient care is taken not to injure the opposite septal mucous membrane; and providing in cases in which the subsequent swelling is marked, a probe be passed between the opposing surfaces in four or five days.

4. A 4 per cent solution of cocain, according to the formula published, is sufficient in the vast majority of cases to induce complete local anesthesia, three to six applications on a cotton-wound flat applicator being sufficient for the purpose. As a result of experience, especially in cases of marked intumescence, we believe that a spray of adrenalin or suprarenalin gr. ⅛ to the ounce materially assists in producing anesthesia.

5. The objection that the galvano-cautery destroys too much of the mucous membrane, does not obtain if the cauterization is linear, as here recommended, and if it is done properly, whereby very little mucous membrane is destroyed..

6. Scab and crust formation does not occur any oftener following cauterization than after other nasal operations. In fact, it was noted in but very few instances and in some of these a change in the spray solution caused a cessation of this trouble.

7. No packing is needed to prevent hemorrhage and this factor makes the discomfort following the operation very much less than after some other methods.

8. There is very little pain after galvano-cauterization of the turbinated bodies.

IV.

THE TREATMENT OF ACUTE AND CHRONIC MAXILLARY SINUSITIS.

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The treatment of a maxillary sinusitis will of course depend to a certain extent upon the cause, and for this reason, all pathologic processes about the roots of the teeth must be carefully looked into and when present removed.

Diseased roots, however, are not frequent etiologic factors, as by far the larger number of cases of antral disease are secondary to pathologic conditions in the nose.

Treatment of Acute Maxillary Sinusitis:—In the majority of the cases of acute inflammation of the antral mucous membrane, a policy of conservative non-interference is best. By this I do not wish to be understood that nothing should be done, but that not *too* much should be done at first. We are probably all agreed on this point. Proper treatment of the nasal condition will in the majority of the cases be all that is necessary. When the mucous membrane is much congested, particularly in the middle meatus, the use of equal parts of a weak cocain and adrenalin solution is extremely useful.

I am in the habit of saturating pledgets of cotton with this solution, allowing it to remain in the nose for a time. As there is usually a certain amount of pus in the nostrils, and as acute maxillary sinusitis so commonly complicates influenza, when the nasal mucous membrane is very much congested anyway, the use of sprays, particularly coarse sprays, is not without the danger of carrying infection to the middle ear. A very fine spray of a 1,20,000 or 1-30,000 adrenalin, with a little cocain, may be used after the acute symptoms have partially subsided, but during the acute stage, the cotton pledgets are safer.

I wish to take this opportunity to say a word against the use of the ordinary douche by patients themselves, in the treatment of acute conditions of the sinuses. In a patient's hands this is sometimes a dangerous thing to use.

The writer has had two severe cases of otitis media resulting from the use of the douche, the patients, in both cases, having received the douche from a general practitioner. During an acute sinusitis, the nasal mucosa is usually very much inflamed, and with the presence of pus, an infection can, as before stated, be readily conveyed to the middle ear by way of the Eustachian tube. If it is necessary to wash out the nose, it should be done by the attending physician and not by the patient.

Inhalations from a steam atomizer or croup kettle, and hot external applications to the antral region, are very useful. I am in the habit of using a mixture of compound tincture of benzoin, oil of turpentine and tincture of hyoscyamus in a steam atomizer or croup kettle, and having it inhaled through the nose. If free drainage, and some relief from pain, should not be obtained by these measures in 48 hours, paracentesis may have to be resorted to, particularly if the tension symptoms are great.

Puncturing the antrum through the inferior meatus where the naso-antral wall is thinnest, usually about an inch back, is a simple procedure, but should be performed with strict aspesis. A sterile, warm, saline solution answers very well for irrigating the antrum. In some acute cases, a single irrigation will suffice, in others, if the discharge from the antrum persists, it may have to be done a number of times. In such cases a temporary opening through the inferior meatus, at the lowest possible point, in order to obtain good drainage, may have to be made. The antrum can then be easily washed out.

We read much about washing out the antrum through the natural opening. Now while this can be done in cases of chronic empyema, I must confess that when the nasal mucosa is much congested, except in unusual cases, I believe it is not at all as easily accomplished in acute cases, as we are often led to believe. An oil spray of menthol and albolene, or menthol, albolene and hydrocarbolene, to which is added a small amount of cocain or adrenalin, is very useful while the nasal mucosa is much congested.

Perhaps something should be said concerning the constitutional treatment of acute maxillary sinusitis. In the beginning of an attack, calomel, followed by a saline, and drop doses of aconite repeated until the patient perspires freely, are useful in relieving the congestion of the mucous membrane. I do not believe that the coal tar products are of much service in controlling the pain, although occasionally 5 gr. doses of phenacetine or migraine tablets, repeated as often as necessary, will afford some relief. It is always wise to stimulate patients somewhat while giving coal tar products, because symptoms of cardiac depression have been known to develop after comparatively small doses of such drugs, particularly acetanilid. Morphin should not be used, because just as in acute frontal sinusitis or mastoiditis, it masks the symptoms to such an extent at times, that well marked tension symptoms might be overlooked.

In connection with the question of irrigating the maxillary antrum, it is interesting to determine whether it is possible, as stated by Lermoyez (Annales de Maladies de l'Oreille du Larynx, du Nez, etc., Nov., 1902), for the frontal sinus to become infected by carrying some infected material into the sinus during irrigations of the antrum of Highmore, either by the way of hiatus semilunaris, or even more directly, when a direct communication exists between the frontal sinus and antrum. Menzel (Archiv. für Laryngologie und Rhinologie Bd. XVII, Heft III, 1905), has shown by his experiments in cadavers, that this is not possible.

His conclusions are briefly as follows: The irrigating fluid injected through an opening into the antrum of Highmore only reached the frontal sinus when an external opening had also been made into the sinus. In all the trials made, in which no external opening had been made into the frontal sinus, there was not a single case in which any of the irrigating fluid, even when forcibly injected into the antrum, reached the frontal sinus.

The sinus being filled with air, will not allow the entrance of any of the irrigating fluid. In cases, on the other hand, in which an external opening had been made into the frontal sinus, the irrigating fluid could be readily forced from the antrum into the sinus.

These investigations of Menzel would seem to be rather conclusive as showing that the frontal sinus can not be readily infected during irrigations of the antrum.

It is of particular importance in the acute cases to correct any nasal condition interfering with proper drainage from the antrum.

To come now to the treatment of chronic maxillary sinusitis, which as a rule is a chronic empyema, I do not think that any methods of treatment except the operative ones need be considered.

Considering first the operation through the naso-antral wall, it may be said that while this method is very successful in selected cases, in the writer's experience at least, it is not always followed by the best results. The writer has operated on a few cases of chronic antral empyema by this method, and in all but one case, the results were not good, the discharge did not entirely cease, and in two cases the radical operation through the canine fossa had to be performed eventually. In each case, a large opening had been made through the internal wall, after resecting a little more than the anterior portion of the inferior turbinate, and the degenerated antral membrane and granulations were removed as thoroughly as possible through the nasal opening. Perhaps the writer's technique was faulty in some way, or perhaps the opening through the naso-antral wall was not large enough. This method has many strong advocates, however, such as G. L. Richards, Freer, Rethi, Curtis, Myles and others. It is perhaps true, as stated by Freer (The Antrum of Highmore: The Removal of the Greater Part of its Inner Wall Through the Nostril for Empyema. *The Laryngoscope,* May, 1905), that many of the operations through the naso-antral wall are not successful, because not enough of the internal wall is removed.

Rethi (Wiener klinische Wochenschrift, No. 34, 1904) recommends the removal of the anterior two-thirds of the inferior turbinate, and an extensive resection of the nasal wall of the antrum both in the inferior and middle meatuses.

Claoue (*Semaine Medicale,* Oct. 15, 1902) makes a large window through the inferior meatus.

H. H. Curtis (*The Laryngoscope,* October, 1903) reports an operation in which after the anterior third of the inferior turbinate is resected, an opening is made through the lower part of the inner antral wall with a trephine and enlarged with a burr. Case reports were not given in this paper.

Richards (*Journal of the American Medical Association,* Sept. 16, 1905) reports good results with this method, because he states "that in many cases the antral mucous membrane is not particularly degenerated." A permanent opening is usually established through the naso-antral wall only in the chronic cases, and in the majority of these the membrane is not only degenerated but greatly thickened.

Coakley's investigations prove this conclusively. (Observations upon the Pathology of Chronic Suppurative Inflammations of the Antrum of Highmore, *Trans. Amer. Laryn. Ass.,* 1902.)

The pathologic changes in the cases examined by him showed great thickening of the mucous membrane in every case. This he found was due to an increase in the loose connective tissue layer beneath the epithelium.

I do not think that the operation through the naso-antral wall will turn out to be permanently successful in every chronic case where this thickening and degeneration of the antral mucous membrane exists.

Richards also states, however, "that if the condition does not improve after a reasonable length of time with this method, any nasal operation alone will not be sufficient, and nothing less than the radical operation through the canine fossa will bring about a cure." The rule in all operative work upon the maxillary sinus, just as in the case of the frontal sinus, should be to perform the operation that will be followed by an obliteration of the sinus. Such an operation, too, should be performed, that every part of the sinus can be directly inspected. This is not easy in operations through the nose. We all know how difficult it is to maintain an opening through the naso-antral wall, even when a large opening is made. Granulations will develop and the opening will become small in a short time. In selected cases, however, this operation is undoubtedly sometimes followed by excellent results, for which we have the testimony of the careful observers mentioned.

Where no ethmoid disease exists, and where the nostril does not contain numerous polypi, this operation may be tried first. When multiple polypi (a common symptom of chronic sinusitis) exist in the nose, in conjunction with a chronic purulent discharge from the antrum, the antral mucous membrane will be found greatly thickened and degenerated in every case, in fact, in many cases the antrum itself will be found with polypi and granulations.

In such cases, where we have almost a positive assurance that the antrum will be found greatly diseased, it seems a better plan to perform the radical operation in the first place, rather than to establish an opening through the naso-antral wall and then later perhaps being compelled to perform the radical operation any way.

Nothing but the radical operation, the Caldwell-Luc, or some modification, and the complete removal of the antral mucous membrane will result in a cure in many such cases.

I will not describe the technic of the radical operation, as it is so familiar to everyone. Just as much of the anterior wall as possible should be removed and all of the mucous membrane.

The writer has found the Luc forceps very useful for rapidly removing polypi and granulations from the antral cavity.

It is almost impossible to remove all of the degenerated membrane by any except the radical operation. The Coakley lamps that are so useful in frontal sinus work, are of the greatest service for inspecting the antrum while operating.

There is no positive assurance, in cases where the operation through the naso-antral wall has been performed, and the opening is finally allowed to close, that the sinus may not again become infected, particularly during influenza epidemics.

In conclusion the writer would briefly report the two following, rather unusual, cases of chronic antral disease.

Mr. J. L., merchant, aged 45 years, has been under the writer's care for several years for recurring nasal polypi. During the past four years, polypi have been frequently removed from the left nostril. Antral disease was discovered when he first came under observation, but he was always satisfied with the relief obtained after the removal of the polypi, and persistently refused any other operative work. During the past year the discharge of pus was so profuse, the polypi recurring about every two months, and he suffered so much from pain in the left half of the head and in the eye that he consented to the radical operation. This was performed in the usual way and the left antrum, which was very large, was found filled with pus and a mass of apparent polypi and soft granulations. There was very free bleeding when these were cleared out with Luc's forceps. The mucous membrane, which was greatly degenerated and thickened, was removed with curettes. It is now a number of months since the operation has been performed and there is no discharge from the nose, the left nostril being entirely clean. The histologic examination of the mass removed from the antrum is interesting. It is as follows:

Bender Hygienic Laboratory, Albany, N. Y.

The specimen removed from the antrum shows a very rapidly growing papillary polypi, with infection, degeneration and necrosis. There is no definite evidence of malignancy, but from the general appearance of the tumor, I would advise careful watch for recurrence.

Very truly yours, R. M. Pearce, Director.

This examination explains the rapid recurrence in the nostril after each removal of the growths. The histologic examination is also of interest, because it shows perhaps the first stage in the change of a benign to a malignant growth. The earlier examinations of the growths removed from the nose, in this case, showed they were the ordinary polypi. The last examination of the growths removed from the nose also showed, however, a beginning change in the histologic structure.

The second case is that of a young woman, aged 36 years. She has had a purulent discharge from the right nostril for years. Transillumination showed a shadow under the right eye, and a dark pupil. On examination numerous polypi were found in the middle meatus of the right nostril. The anterior ends of both inferior and middle turbinates were much enlarged and edematous.

She would not consent to the radical operation, so after removing the polypi, the anterior end of the middle turbinate, and a little more than the anterior third of the inferior turbinate, an opening was made through the inferior meatus. The antrum was filled with soft granulations and there was a free discharge of pus. The patient's general condition was so poor that the pus from the antrum was subjected to a microscopic examination. It was found to contain tubercle bacilli. None were found in the sputum, however, nor could any general tuberculosis be discovered. Coakley, in the paper before mentioned, reports the case of a young man, aged 26 years, with double antral disease. Microscopic examination of the scrapings from the left antrum showed the presence of giant cells and a few tubercle bacilli. Sputum examinations in this case were also negative.

Before closing this paper the writer would like to say a word about the use of "somnoform" in operations upon the upper air passages.

It is an admirable and safe anesthetic, and can be used to great advantage as a preliminary step in the administration of ether. It is used in a special somnoform inhaler. It is composed of chlorid of ethyl 60 per cent, chlorid of methyl

35 per cent and bromid of ethyl 5 per cent. The patient is completely under the influence of somnoform in thirty or forty seconds, and then the administration of ether can be started at once. It does not produce cyanosis as is the case with ordinary nitrous oxid gas. It certainly shortens the administration of a general anesthetic very much.

V.

THE USE OF THE BURR IN THE MASTOID OPERATION.

By A. Barkan, M. D.,

SAN FRANCISCO, CAL.

There exist probably no more honest seekers for truth than medical men. The taking care of health, the saving of life, is the goal we endeavor to reach. The task is so noble, the road often so dark! If then, an impediment, no matter how slight, exists, whose removal might tend to make our work easier and above all, safer, the duty in the matter is clear. The more so, if the surgical path before us is narrow and tortuous, and beset with difficulties on all sides. Having enjoyed exceptional opportunities, during two periods of work at Prof. Schwartze's clinic, for the study of mastoid operations, then as now exclusively performed with chisel and mallet, I used these instruments with fair satisfaction for a number of years. Then I witnessed for the first time Prof. Macewen do a radical operation with the burr of a Philadelphia make, driven by a simple but effective surgical hand engine. I was so impressed with the greater ease, the infinitely greater safety, the artistic feature of handling the simple instrument, that from that date, about ten years ago, to this, with the exception of a very few operations done in the country or in the hospital when power unexpectedly gave out—a very unusual occurrence indeed,—I have used no other instrument than the burr. A series of over 100 cases done in this way allows me to pass an opinion as to the efficiency of this method and to speak from the standpoint of the aural surgeon, practically and briefly.

For several years I used the same dental surgical engine driven by a nurse's foot, with which Macewen did, as far as I know, all of his path-finding work in aural and brain surgery. Then, at his direct suggestion, White & Co., of Philadelphia, constructed a surgical engine, driven by the direct current, which I have used with the greatest satisfaction. The cut through skin and periosteum is made as usual. Macewen's triangle is well exposed; then the largest of the three globe-shaped burrs is applied to the surface of the bone in the triangle, the handle of the instrument is held like a pen, and moderate pressure is applied on the bone. If the driving cords of the instrument are properly adjusted, and the current supply of the right intensity, the revolutions of the burr produce, within a few minutes, a channel which, lying parallel to the posterior wall and a little above and behind the meatus, tends toward the antrum. An accumulation of bone sand between the furrows of the burr is practically prevented by an attendant dropping a sterilized normal saline solution upon the burr. According to the operator's individual inclination and the density of the bone, the rate varies at which the burr is allowed to penetrate into the depth. Considering that the surface of the bone attacked by the burr is rendered smooth at once and needs no beveling off with the chisel, the rate of progress is about as good as that in chisel work. The large sized burr is used until the antrum is reached. As the canal progresses in depth, the outer edges of the wound are beveled down and the opening enlarged. The burr need not be changed at all, or if changed for one of equal or smaller size, the mechanism of the handle is so perfect that the change is accomplished in a few seconds' time by the nurse who attends to the instrument, while the surgeon explores with a Macewen searcher one or the other of the peripheral cells of the mastoid, granulation tissue, or perhaps the bone which overlies the sinus, if the latter be projecting forward, as it has done in a great many cases of my series. In this very instance the beauty of working with the burr is at once telling, for as the bluish color indicating the nearness of the sinus becomes apparent, the burr in the surgeon's hand continues to remove layer after layer of bone until the sinus is safely exposed. This shaving off of the bone, overlying the sinus, is so easily and safely accomplished that in the hands of the beginner in mastoid work, who is liable to propel his chisel with smart strokes, the burr is the infinitely safer instrument, and will, I am persuaded, often prevent accidental opening of the sinus.

The antrum being found and cleaned, the removal of the posterior osseous wall is just as readily accomplished by the burr. At first the large sized burr is used and as the medial end of the posterior wall is reached, it is changed for one of medium size. I have found a strabismus hook useful in ascertaining how much of the spur is still left standing. A competent assistant keeps the same in position, hugging the spur with it, as it were, until the burr comes in contact with it. In that way, the spur is entirely removed and lesion of the facial canal is avoided. The removal of the bone overlying the aditus, the smoothing off of the facial ridge, or the removal of diseased bone in all parts of the operative field is accomplished with the burr.

The smaller ones are used in the depths. An electric forehead lamp is brought into use if necessary. Of late years I have not used any protector whatever, neither Stacke's nor the strabismus hook, but proceed slowly and cautiously in the depth. If further work is to be done to the tegmen of the antrum or tympanum, still the burr may be used to great advantage.

If it be necessary to expose the middle fossa, that can be done certainly with as much ease and safety with the burr as when the burr is used to expose the lateral sinus. A direct lesion of the facial nerve attributable to the burr is only possible when caries has extended into the Fallopian canal. That has happened in a very few cases, and can not be laid to the account of the burr.

That the shock of the operation, in all cases, but especially where there are cerebral complications threatening or already present, is infinitely smaller than when chisel and mallet are used, is a proposition so clear, so humane, I should say, that I fail to understand the almost exclusive use which is still made of the chisel. Conceded that in the hands of lightning operators, the radical operation may be possibly accomplished with advantage of about 10 or 15 minutes' time, I feel sure that this is accomplished at the expense of safety; the burr then recommends itself for use because it is by far the safest of the two instruments; lesions of the lateral sinus and of the dura in the middle fossa may be avoided with certainty; it produces the slightest amount of mechanical shock in and around the temporal bone; it bevels off the edges of the cavity to a nicety, and prevents entirely spiculae of bone becoming loosened, causing mischief.

I venture to assure my colleagues that having once witnessed mastoid work done with a surgical engine of modern make, whether driven by electricity or by hand or foot, they would not be willing to submit their own heads for work of this kind to the mallet and chisel.

While the surgical engine is perhaps a trifle too large to be carried about to the patient's house, the simple surgical engine, driven by hand or foot, might do very well in such a case. The installation of the perfected electrical instrument, however, is, to my mind, a necessity in every ear hospital.

In conclusion I wish to remind my colleagues of the words of the master. They are put down on pages 299 and 303 of Macewen's work, "Pyogenic Infective Diseases of the Brain and Spinal Cord." As this work, so inexhaustible in what it teaches, as far I know, has not had a second edition since its first appearance in 1893, whereas a flood of aural text books have made their appearance, I will be forgiven for referring again to it. A master of the chisel in other fields of surgery, Macewen advises most emphatically against its use in mastoid work. Can we afford to neglect such advice? Must we not give it a fair, unprejudiced trial, using the best instruments at our hand for that purpose? He neglects a sacred duty who fails to do so.

The following is Macewen's expression on the subject:

"Most surgeons use the chisel, driven by a mallet, for opening the mastoid antrum. No doubt it is often successfully exposed in this way, and in lack of a better instrument, the chisel may be used. Its use, however, for opening the mastoid antrum is objectionable; first, because in operating upon a restricted area, surrounded by and full of apertures, some containing delicate structures, the wounding of which may occasion serious and even fatal results, the antrum being situated at a variable depth from the surface, the intervening osseous tissue being of various consistency, it is a source of danger to use a chisel driven by a mallet, which may be suddenly impelled into the interior of one of those spaces or into the cerebellum, brain or sigmoid.

"Such accidents have occurred during attempts to open the mastoid antrum. The sigmoid sinus has frequently been accidentally opened by the chisel, several of the cases surviving, though a number have died. In four unpublished cases which have been communicated to the author, four surgeons, in their several endeavors to open the mastoid antrum, have accidentally driven the chisel into the sigmoid sinus. In each of these there was profuse hemorrhage, causing abandonment of the operation; the parts being plugged to arrest bleeding. Three of these four patients ultimately died. In two, the surgeons believed that death was not hastened by the accident, but from meningeal complications which previously existed. It is probable that a fatal issue would have occurred in any case. In one, the amount of hemorrhage within a few seconds was very great. The patient died in forty-eight hours from extensive cerebro-spinal meningitis. A hemorrhage of considerable size was found in the subdural space in the same cerebellar fossa. The fourth case recovered.

"On one occasion, a young surgeon, in endeavoring to open the antrum with a chisel, found, on giving it an impact with the hammer, that the instrument suddenly entered a large cavity, from which pus issued. At post mortem examination it was seen that the chisel had penetrated the sigmoid groove, pushed aside the sinus, which was fortunately thrombosed, and entered the cerebellum, from which, on withdrawal of the instrument, pus flowed.

"Secondly, the repeated blows with the hammer impart considerable vibration to the mastoid and adjoining structures, and when the tegmen tympani or the sigmoid groove is thinned, the concussion may cause these thinned and pliable structures to give way, or cause a rupture of the granulations covering them, and thus permit inoculation of the fresh wounds, in the membranes, or in the brain itself. Pus within the brain or cerebellum, received through concussion of violent vibrations or shocks, could easily be scattered, or a large abscess near the ventricles or meninges might, by the violent impacts conveyed to it, burst into the ventricles or meninges, thus producing serious if not fatal results. On one occasion (in a case reported to the author by the surgeon in charge), while the chisel and mallet were being vigorously applied to open a mastoid antrum, the patient's breathing was suddenly arrested; the relations of a large cerebellar abscess which was present being probably disturbed by the communicated vibrations, as there was no laryngeal obstruction.

"Thirdly, the aperture left by the chisel is rough and ragged compared with the polished surface and beveled edges obtained with burr, which greatly facilitates the after-dressing and treatment."

920 Market Street.

VI.

NON-DIPHTHERITIC MEMBRANOUS PHARYNGITIS AND RHINITIS WITH HYPERPYREXIA AND AN UNUSUAL NUMBER OF COMPLICATIONS—REPORT OF CASE.*

By James F. McCaw, M. D.,

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The case which affords the basis for this paper, I saw in consultation with Dr. J. D. Spencer and Dr. C. N. Bibbins, March 15, 1904, when the following history was obtained.

Patient, female, aged 28 years. Mother died of pulmonary tuberculosis. While in New York City, about four and a half years ago, she developed an acute purulent otitis media, followed by mastoiditis on the left side, and was operated upon for the same by a very eminent general surgeon, after consultation with a prominent member of this society. From this she made an uneventful recovery, and had been perfectly well until six weeks before, when she suffered from an attack of influenza.

Although up and around, she was still weak and exhausted, not having fully recovered from her influenza attack, when her present illness began one week ago with a severe sore throat, a profuse watery nasal discharge, followed by a chill, high rise of temperature, rapid pulse and marked prostration. About twelve hours later, a pseudo-membrane began to develop, first on the tonsils, rapidly spreading to the soft palate and tongue, extending thence to the pharynx, post-nasal space and nares. The nostrils were so completely occluded that it was impossible to force air through them thirty-six hours from the beginning of her illness. Twelve hours later redness, swelling, edema and pain had developed over the superior maxillary and infraorbital region of both sides, more pronounced, however, over the right. Pain in the left ear, with subsequent purulent discharge and the same condition in the right, followed in quick succession.

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*Read at the Eastern Section Meeting of the American Laryngological, Rhinological and Otological Society at Syracuse, N. Y., February 10th, 1906.

I first saw the case at this stage of development and upon examination found the following conditions: Patient profoundly prostrated, mental hebetude, temperature 104.5° F., pulse 126, and swallowing difficult. There were noticeable chemosis and proptosis of the right eye, redness and swelling over the antral and infraorbital region on each side, with pain and tenderness on pressure over the same areas. Nasal obstruction was complete. Each nostril was found occluded with a thick grayish-white membrane which completely filled the cavities. This membrane covered the post-nasal space, extended down the posterior and lateral pharyngeal walls to the tonsils and soft palate and involved the lateral walls of the buccal cavity and tongue as far forward as the tip. This pseudo-membrane was deposited on the tonsils, soft palate, tongue and buccal cavity in the form of large islands, between which was red and highly inflamed mucous membrane; while in the nasal chambers, post-nasal space and pharynx its continuity seemed to be unbroken. Any attempt at removal of this deposit left a raw and bleeding surface.

The membrana tympani in each ear was very highly inflamed, edematous and bulging, with a small perforation in the lower posterior quadrant of each, from which bead-like drops of pulsating pus were oozing. No swelling or redness over the mastoids, but slight tenderness on deep pressure over the left. Each membrana tympani was freely incised, and an examination of the pus from these and swabbings from the throat and nostrils showed staphylococci present in great numbers with a few streptococci. Klebs-Loefler bacillus was absent.

As a result of this finding, I attempted to clear the nostrils of the deposit as thoroughly as possible without treating the mucous membrane too harshly, and instituted regular syringing of the same with bichloride solution 1-10,000, followed by a mild alkaline solution every three hours. The other areas of infection were treated in a similar manner. This, together with supporting treatment, constituted my method of attack.

For the next four days, the general condition of the patient seemed to remain about the same, temperature ranged between 104° and 105.5° F., pulse 120 to 140; mental hebetude alternating with mild delirium supervened. About this time there was noticed less activity in the reformation of the false membrane, it was less tenaceous, coming away more easily and not leaving that extremely red and bleeding surface, as had previously occurred. The swelling and redness over the infraorbital and antral regions slowly subsided and tenderness disappeared. The false membrane had entirely disappeared in ten days and her general condition improved, but there had in the meantime appeared some swelling, redness and increased tenderness over the left mastoid region. About this time pronounced gastro-intestinal symptoms supervened, followed by tympanites, but only slight diarrhea and tenderness. To this was added a most annoying cystitis with constant and severe pain. With these developments her temperature again became high with frequent chilly sensations. A Widal test gave a negative result.

In view of her general condition, which was very bad at this time, I did not feel warranted in subjecting her to the shock of opening the mastoid, but was contented with keeping the middle ear thoroughly drained, meeting the other indications, and getting the patient in a condition where I felt her life would not be jeopardized by a mastoid operation. About one week from this time, I opened the mastoid, cutting down through the cicatricial tissue of the old wound opening into an abscess cavity. Although some difficulty was experienced in locating the antrum on account of distorted landmarks, this was finally accomplished. The zygomatic cells, those in the upper posterior portion, and the tip cells which had been left at the time of her previous operation were found involved and necrotic. All diseased tissue was thoroughly curetted away and the mastoid wound dressed in the usual manner.

From this the patient rallied nicely and was convalescing satisfactorily when two weeks later she began to complain of a fullness and pain in the left side of throat, temperature 101°, pulse accelerated. Upon examination there could be seen on the left side of the posterior wall of pharynx, on a line with the soft palate and extending upward, a deep purplish red, slightly tumefied area. Pronounced bulging of this area, crowding the soft palate forward, tenderness to pressure and an indurated feeling at a corresponding point on the neck, dysphagia and increased constitutional symptoms supervened in thirty-six hours; at which time a large retro-pharyngeal collection of pus was evacuated with immediate relief. From this time on the patient made a rather slow but uneventful recovery.

In medical literature there is a lack of unanimity among authors regarding the nature and classification of these cases. They are described as diphtheritic, diphtheroid, fibrinous and membranous pharyngitis and rhinitis, phlegmonous pharyngitis, streptococcus infection, staphylococcus infection, etc., all of which is very confusing.

The question, then, of etiology and diagnosis becomes one of interest and importance. In my own case I must confess that at first I accepted the report of the bacteriologist with some skepticism, as the clinical evidence seemed to warrant a diagnosis of diphtheritic infection. However, after a more careful study of the case, we find abundant evidence to account for the unusual symptoms and phenomena present. Most authors tell us that non-diphtheritic, membranous or fibrinous rhinitis or pharyngitis is a mild disease with only slight constitutional symptoms, usually occurring in children, the temperature rarely going above 101° in the severer cases, and in some the symptoms are insignificant after the second day. While this may be so in the majority of cases, it was clearly the exception here. The wide distribution of the false membrane, with evident involvement of the nasal accessory sinuses, the hyperpyrexia and extreme prostration, evidence of a profound and virulent infection, at first seem incompatible with the bacteriological finding, but when it is considered that this patient was convalescing from an attack of influenza, her physical condition and resisting power of the tissues necessarily low, it is easy to account for the unusual activity and virulence of the invading organism, and the number of subsequent complications.

The mastoid complication was of added interest as further evidence in substantiating the views of those who strongly advocate the entire removal of all mastoid cells, including the zygomatic group and tip whenever the process is attacked surgically. Where this is not done and a second operation becomes necessary at any time, it is made more difficult from the destruction of the surgical landmarks.

In considering the complicating retro-pharyngeal abscess, the possibility of an extension or burrowing of pus from the mastoid wound might be thought of, but the wound was perfectly clean, and although searched for, no opening of communication could be detected. Another point against this view is the fact that the first evidence of its appearance was in the posterior pharyngeal wall and later was felt in the neck. From this we conclude it was another complication of the primary infection.

The last, but by no means the least in interest, is the pathology of these cases. The fact has been clearly demonstrated by experimentation that general systematic infection may take place by dissemination of the poison from the upper air passages; in some cases passing through the lymphatics with great enlargement of the cervical lymph glands; in others directly into the blood current by way of the small capillaries and so reaching the general circulation. These facts have been proven beyond question and I think they are now accepted by most observers.

The question naturally suggests itself, why is it, that in some cases the clinical evidence of general infection are so much more profound, and the local manifestation so different from others, in which the infecting agent is apparently the same? Poynton, before the British Medical Association, sums up the situation very clearly when he says: "That border line between pathogenic and non-pathogenic is, in my opinion, the weak side of bacteriology at the present time. Because of the obscurity of this most pressing question, I have always fought hard against any assumption that whether a sore throat is septic, or rheumatic, or catarrhal, is simply a question of the resistance of the patient. In opposition, I maintain that we do not know when we look at such a throat whether the fate of the patient turns upon his resisting powers or upon some special properties in the infective agent. Certainly I think we shall admit, so far as diphtheria is concerned, much rests with the micro-organisms, and though in those other infections so vaguely termed septic, we are at present in confusion, I hold firmly to the view that when you have great clinical differences, then you have some special factor in the infective agent. I admit the factor of personal resistance, but not as the explanation of the great differences that there are between the illnesses that follow rheumatic, septic and catarrhal sore throats. In the search for these differences, difficult and slow though it may be, lies the hope of the discovery of the special poisons and their antidotes." He also alludes to the fact that probably infection from the throat may occur without any appreciable local symptoms, that the local inflammation is only a measure of the local disease, and not of the tendency to general infection.

VII.

REPORT OF A CASE OF DEFORMITY OF THE AURICLE FROM PERICHRONDITIS FOLLOWING RADICAL OPERATION FOR CHRONIC MIDDLE EAR SUPPURATION AND MULTIPLE FURUNCLES.

By William H. Haskin, M. D.,

NEW YORK.

The patient, Mrs. M. W., age 36 years, was referred to me by Dr. T. J. Harris on June 6, 1905. His records report that she complained of headaches, dropping in the posterior nares and oppressive breathing.

On April 17th a spur was removed from the right side of the septum, and treatment was given twice weekly for hypertrophic conditions throughout.

June 7th still complained of headaches, though breathing was easier and post-nasal dropping less. As the pains were always referred to the left side of the head, she was sent to me for an ear examination.

Her history to me was that she had had a severe attack of diphtheria seven years ago, followed by an abscess in the left ear which ran steadily for five months. She also said that all her troubles dated from that time. She complained of marked deafness in left ear, of severe ear-aches at intervals and of hearing her own voice repeat itself, in the left ear.

Hearing tests showed: Watch on contact only; Acoumeter, 8 inches; Weber, + left; Rinné B C better than A C for C_2 fork.

The canal appeared normal. The membrana tympani presented marked retraction of lower and anterior portions, with extensive calcareous deposits and a large perforation into the attic which appeared full of cholesteatoma, but dry. The Eustachian tube was freely open and dry. There were no evidences of acute inflammatory action present, and no treatment was advised as long as existing conditions remained.

June 19th she returned with an extensive furuncle at the meatus which was evacuated, and on its subsidence the attic was found to be discharging.

June 25th another furuncle appeared, and this was accompanied by a greenish, very offensive pus, in which were found the bacillus pyocyaneus from the middle ear. From that date the patient got no relief from pain, and the superior and posterior walls apparently became involved throughout. A deep incision from the attic outward was made under gas, but did not improve the condition. The patient was using hot bichlorid douches and external hot poultices.

On July 12, 1905, she was admitted, on the advice of Dr. Harris, and operated upon, on the following day, under gas and ether anesthesia. The usual radical operation was performed, there being present throughout a condensing osteitis. The antrum and attic were found filled with cholesteatoma and granulations, which were thoroughly removed. The facial canal was exposed in its descending portion, but the nerve was not severed. The canal was split and then packed with iodoform gauze. The posterior wound was sutured with silk, and sterile dressings were used.

Subsequent history: Written by Dr. Foster, the house surgeon.

July 15. Outer dressing changed. Wound clean and dry.

July 19. First dressing. Wound clean and looking well. Stitches removed from posterior wound. Healing here perfect.

July 22. Wound inside looking well. Considerable soreness and redness about canal entrance, especially above where flap was cut.

July 23-25. Wound granulating nicely, but inflammation about canal grows worse. Apparently a chondritis or perichondritis has set in. Taken home.

From this time until August 4th patient was dressed in clinic. Swelling about canal increased and spread to whole of cartilaginous auricle. Patient suffered intensely and was re-admitted to hospital August 4, 1905.

August 5. Intense inflammation of auricle and much pain. Dressed with Burrow's solution.

August 7. Swelling of auricle continues to increase; feeling of fluctuation in it. Burrow's solution continued.

August 10. Auricle paler, but more fluctuating; pain still severe.

August 11. Auricle incised under gas anesthesia. Opening made behind. Considerable pus evacuated. Packed with iodoform gauze. Middle ear looking well.

August 13. Packing changed. Considerable pus evacuated. Still much deformity of auricle and a great deal of pain. Patient requires some narcotic almost every night.

This condition continued with little change for the next two weeks. It was apparent that the cartilage was coming away little by little.

After September 1st the discharge became more scanty and the auricle began to contract. When she was discharged September 12th the auricle was almost devoid of cartilage and the posterior wound in it clean. However, there had set up some swelling about the tragus, with some tenderness.

September 13. Small fistula in posterior surface of auricle. Hard mass just under skin in front of tragus has been gradually swelling and apparently fluctuating. Advised opening, but patient refused, so hot poultices were applied. Middle ear perfectly dry. No improvement in hearing.

Present condition:

Auricle badly deformed from destruction of cartilage. Canal and middle ear dry and completely healed. No pain. Hearing the same as before operation. No ill effect from opening the facial canal.

The literature of perichondritis is comparatively scarce. Politzer after describing it makes the remark that since the advent of the radical operation this condition is not so rare.

Dr. E. Gruening, in the *Archives of Otology,* 1890, said that he had seen but two cases.

Dr. Ferer, in the same number of the *Archives,* said that cases were very rare, only three observers, Chimani, H. Knapp and O. D. Pomeroy having reported any.

Dr. Kipp says it might be caused by too deep incisions into the cartilage in cases of furunculosis.

Dr. H. Knapp, in the *Archives* of 1890, 1898, 1902, reports cases, but always idiopathic.

So far as I have been able to observe from published reports, there are none following the operation for the radical cure, but I feel this must be due to poor indexing, for the Index Medicus, the Surgeon General's Report of the Medical Library and others were searched with the aid of the librarian.

I believe that this case was due to the previous condition of furunculosis, and not to infection from the radical operation, properly speaking, for the wound healed by first intention, and the bony cavity healed without interruption, as can be seen.

VIII.

ACTINOMYCOSIS OF THE MIDDLE EAR, WITH POST-MORTEM FINDINGS.

By Joseph C. Beck, M. D.,

CHICAGO, ILL.

Inasmuch as cases of actinomycosis of the middle ear belong to the very rarely observed affections, especially so when this is the cause of death, I believe a thorough description and report of the same will be of more than ordinary interest. This case has already been reported from the clinical standpoint by Zaufal, of Prague, and by myself, with some reference to the post-mortem findings, and a short abstract of the same which follows:

Carl J., 54 years old, farmer, always healthy, never any ear, nose or throat trouble, had had for about six months swelling back of the ear and the side of the neck on the left side. This swelling was at first hard, soon softened and was never painful. Later on, a third swelling appeared, also on the left side of the neck, which opened and discharged pus through a small fistula. When the first swelling appeared he noticed that his hearing became affected, but no subjective symptoms appeared.

Status. A well developed man, showing no pathological changes in his heart, lungs, abdominal viscera, cerebro-spinal and genito-urinary organs.

The nose. Hypertrophic rhinitis, septum deviated to the left.

Post-nasal space. Examination is negative.

The mouth. The majority of his teeth are absent, and the alveoli are smooth. Some of the teeth are carious, but no periostitis or fistulae can be found anywhere.

The tonsils. Small, pale and with no ulceration. They are not painful on pressure, and no pus exudes on compression. The contents of two large lacunae removed and examined microscopically show various kinds of cocci, and bacilli and stain by the Gram method, showing fragments of threads, which resemble the arrangement of actinomyces.

Oropharynx. Negative.

The ears. Functional test:

R.	L.
vox, 6 meters,	vox 0.5 meters,
v. s., 1 meter.	v. s.

The Rinné test is positive on the right and negative on the left, and the Weber test lateralizes to the left.

The external canal of the left ear shows no secretion. The upper posterior wall is sagged down so that the external auditory canal presents the slit-shaped appearance, and only a very narrow part of the tympanic membrane can be seen, and that appears grayish in color. The right ear appears normal, except that the membrana tympani is slightly thickened. The pinna on the left side is pushed very markedly forward from the side of the head, and the anterior surface of the mastoid appears edematous, but not painful on pressure or percussion. A swelling about the size of the palm of the hand is situated over the region of the mastoid and reaches downward and backward, but not distinctly fluctuating; it has a very deep red color. Another swelling is situated more anteriorly, passing downward and into the depth of the tissues. It has similar characteristics on palpation and inspection, and has a fistulous opening in the region of the tip of the mastoid. When these swellings are compressed, one can obtain a greenish pus containing small granules. During the patient's stay at the hospital another swelling appeared near the angle of the jaw on the left side, at first very hard, then softening down and soon becoming fluctuating, but it did not communicate with the fistula. By probing the fistula no loose necrotic bone or any rough surface of bone is to be detected.

An operation was decided upon, diagnosis having been made of a chronic suppurative middle ear disease, with mastoid involvement and secondary abscesses in this region, without rupture of the tympanic membrane; the possibility of an actinomycotic process was considered.

Operation. The usual method of operating was pursued as far as the antrum mastoidei, cleaning out all the mastoid cells which were filled with granulations. The characteristic greenish granules of actinomycosis were not found until the depth of the antrum mastoidei was reached. All the abscesses about the region were thoroughly opened up, curetted and drained. All of these cavities contained the greenish pus and granules.

Inasmuch as the microscopic diagnosis of these greenish bodies had not been made, it was decided not to do a radical operation, leaving the ossicles and terminating the operation at this point. Portions of the sternocleido muscle, granulation tissue, greenish bodies and pus were sent to the pathologic institute of Prof. Chiari for examination, and the latter declared that no actinomycosis was present. (I learned from Prof. Chiari that the specimens were sent up after they were too dry and unfit to make a thorough examination and to recognize anything.)

The patient did not show the usual improvement that follows these simple operations; on the contrary, new areas of infiltration developed, these at first very hard, later softened, and discharging large amount of pus and a number of greenish bodies, which Zaufal examined personally, and found to contain the characteristic actinomycosis.

The patient now had considerable pain, and one could see the marked progress of the affection; consequently, another diagnosis was made, namely, actinomycotic process of the temporal bone. It was now one month from the time of the first operation, and the second operation was performed, which was very radical in removing every vestige of diseased bone; thoroughly cleaning out all the pus cavities about the neck and thorough drainage established. Patient lived one week, and just previous to death a third surgical cleaning was necessary in order to relieve him of the tremendous pain that was present, due to the marked distention of the pus cavity. The patient's death was sudden, due to an intracranial hemorrhage which proved to be the ulceration of a huge blood vessel in the vicinity of this destructive process.

Post-Mortem Examination. Conducted by Prof. H. Chiari. The body is well developed, muscular with very little superficial fat; it is pale, with usual post-mortem spots on back. Post-mortem contractures are well pronounced; pupils contracted symmetrically. In the region back of the left ear and lower jaw a T-shaped incision is observed, and from this a number of small incisions lead forward to the side of the neck and backward to the back of the head. Some are united, but most of them are open and granulating, discharging quantities of pus. The soft parietes are pale.

The skull. Measures 57 cm. in the horizontal plane. It is of the usual thickness, and its inner surface corresponds to the usual appearance of the skull. The dura is tense. Sinus falciformis contains a small quantity of liquid blood and fibrin.

The brain. In the subarachnoid space and the undersurface of the cerebullum, medulla oblongata and pons varolii, the base shows especially fresh extravasated blood, but partially coagulated, and a small quantity of this blood was also found in the subdural space at the base of the skull. The basillar arteries are normal. The left vertebral artery at the lowest intracranial portion is very much thickened, partially thrombosed, and soft to the touch. The pachymeninges and the underlying connective tissue in the region of the left arteria vertebralis are infiltrated with pus which contains greenish granules of actinomycosis. The internal meninges are greatly thickened, edematous, extremely congested and can be peeled off readily. The convolutions are of the usual form. The lateral ventricles are dilated, and filled with a reddish serum. The third and fourth ventricles contain a little clotted blood. The brain structure itself is a little harder than normal, and contains a fair amount of blood.

The diaphragm reaches on the right side up to the third rib, and on the left to the fourth.

The air passages. The mucous membrane of the mouth, pharynx and larynx is pale; trachea contains a small amount of mucus.

The teeth are very defective. Central and lateral incisors, the right canine, the second molar (right), and the root of the left canine in the upper jaw are present. The four incisors and the right molar are in good condition. The gingival margin shows no sign of an ulcerative process.

The tongue is negative.

The tonsils are pale, somewhat larger than normal, the right one on cross-section appearing about normal; the left, however, shows a number of dilated crypts, and nodules of yellowish appearance. From the outer margin of the left tonsil and running outward are a number of fistulous tracts, which are markedly infiltrated. These tracts terminate in a large abscess containing actinomycotic granules. Pharyngeal tonsil and ostium tubae are of normal appearance.

A more thorough examination of the field of operation shows that in the deep muscular layers of the left side of the back and neck, also higher in the region of the cervical vertebrae, a number of pus-infiltrated areas of a radiating character exist, and the pus contains many clearly distinguishable greenish bodies of the size of a hemp seed.

The joint surfaces between the epistropheus and atlas, also both atlanto-occipital joints are filled with pus; the articulating cartilage on the left side of the latter joint is absent. The bones are all infiltrated with pus, especially so is the body of the sphenoid, as far as the dorsum of the sella turcica. From the left joint surface of the atlanto-occipital, the pus infiltrations can be very clearly traced to the left side of the squama occipitalae, and the posterior surface of the mastoid process, including the incisurae mastoidei. All these surfaces show plainly that they are bare of periosteum; they are very rough. The foramen mastoidei is laid bare by the operation and locked up with a hard, reddish-brown thrombus. The lateral wall of the processus mastoidei, including the bony posterior superior portion of the external auditory canal, was also removed at the time of the operation. This large defect is covered with unhealthy granulations. The antrum mastoidei and cavum tympani are broadly laid bare, and are filled with a similar kind of granulations. The left Eustachian tube is patent, and its mucous membrane is smooth and pale. The malleus and incus are absent. There is no suppurative process in the bony wall of the cavum tympani. A fistulous tract can be traced with a fine probe from the cavum tympani towards the exposed incisura mastoidei, which was not opened up during the operation. The left sigmoid sinus is filled out with a fine thrombus of a light yellow color, which is firmly adherent. The cervical glands on the left side are somewhat enlarged, and on cross-section show whitish discolorations.

The large cervical vessels on both sides are normal.

The heart, lungs and all abdominal viscera are normal.

Microscopic examination. Dr. Herrick, of Chicago, made serial sections of the left tonsil, and found no actinomycosis therein. The plugs found in the tonsil showed them to be composed of debris, epithelium, leucocytes, but no actinomyces. The lymph follicles showed no pathologic change. The peritonsillar and muscular tissues were infiltrated with pus and showed a few supposedly actinomyces.

The pathologico-anatomic diagnosis is, therefore, as follows:

1. Actinomycosis partis mastoidei ossis temporis sinistri.
2. Actinomycosis ossis sphenobasillaris, et atlantis et epistrophii textus cellulosi et musculorum coli.

3. Haemorrhagia intermeningealis et ruptura arteriae vertebralis sinistrae, suppuratione actinomycotica affectae.

4. Vulnus trepanatione processi mastoidei sinistri.

Portions of the temporal and occipital bones were excised and I examined them microscopically, as well as parr of the ruptured artery in order to determine whether the affection of the artery was due to the actinomycotic process, or whether other microorganisms took part in this most destructive process. Decalcifying the bone, especially the articulating surfaces of the vertebrae, which showed such marked macroscopic changes, I obtained these splendid sections. Using the Gram-Weigert method of straining, also Mallory, we showed distinctly an osteomyelitis with areas characteristic of actinomycosis, and, with an immersion lense can be demonstrated the characteristic ray fungus, with its clubs and threads. The bone itself does not seem to have suffered a great deal of destruction, and shows that the process here is of but recent origin. Other bacteria were not found. The artery shows true actinomycosis within its walls.

EPICRISIS.

The epicrisis of this subject is as follows:

1. Actinomycosis of the middle ear.

2. Propagation of the same to the neighboring structures; that is, soft parts as well as bone at the base of the skull, including the basillar artery.

3. An arteritis actinomycotica, with its final rupture and fatal hemorrhage.

The question one is to ask in this case is how may the middle ear have become infected? Perhaps from the peritonsillar structures, which showed such distinctly actinomycotic changes post-mortem. The other routes whereby the middle ear may have become infected are through the Eustachian tube, through the external auditory meatus, by means of an embolus lodging within the ear, by some of the terminal arteries of the ear, or by the process extending from the lower jaw, a most frequent place for actinomycotic affections.

The literature on this subject is very scarce, and with the exception of this case I have only been able to find one other case of actinomycosis of the middle ear, and that is the case of Majocchi, of Italy, in the Refera Media, 1892, p. 120.

Through the kindness of Professor Ferraninii, of Italy, I was able to obtain the original article of Majocchi, and he states that in his case the actinomycosis was first in the lung, and that during a coughing spell he believes a part of the expectoration infected with actinomycosis was thrown into the Eustachian tube, and by that route infected the middle ear.

Ponfick speaks of a case of affection of the ear by means of the actinomyces, but secondary to an infection of the lower jaw. In his case the external ear was principally involved.

In conclusion, I wish to express my sincerest thanks to my teachers, Prof. H. Chiari and Zaufal, in giving me the opportunity to follow this case from beginning to end, and aiding me in the study of the pathologic investigation of the same.

IX.

KELOID TUMORS.

By George A. Webster, M. D.,
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ASSISTANT AURAL SURGEON, MASSACHUSETTS CHARITY EYE AND EAR INFIRMARY.

My interest in this subject was aroused by seeing in a clinical case, a negress, a keloid growth about the lobule of the ear. It had recurred, larger than ever, a few months after removal.

Synonyms. Cheloid. Kelis, Kelos; Fr. Cheloide; Ger. Knollenkrebs.

Description. We have a tumor of varying size, projecting above the level of the skin in a smooth, flat, hard, well-defined mass. In color it is white, pink, or in negroes, varying with the individual color of the skin.

Its extension in claw-like radiations suggested its name. These tumors grow slowly; become paler and harder with age. Exceptionally they may atrophy in old age. Pain is not common. Pricking, burning and itching sensations may occur.

This form of tumor is comparatively rare.

Pathology. It is a variety of fibroma; an affection of the skin occurring in the middle and lower portions of the corium. We have fine dense bundles of white fibrous connective tissue. Blood vessels are few in the centre, but more numerous at border of tumor. Sebaceous glands and hair follicles are pushed to one side by the growth and often atrophy.

Its origin was formerly thought to be in the adventitia of the vessels and perivascular connective tissue (1). Later investigations do not support this theory of origin (16).

Etiology. Two forms have been recognized: the spontaneous or true, and the cicatricial keloid (2) (6). Probably all are cicatricial (5) (23) (3) (4), following some form of injury to the skin. The following have been mentioned: Perforation of ear lobule for ear-rings, scratches, blisters, scalds, burns, leech bites, mosquito bites, briar or nettle stings, acne, herpes or small-pox; in general, any traumatism or condition leading to scar formation or to vesicular or suppurating eruption. The colored race most frequently suffer. This affection is rare in the very young; usually occurs in middle life; has been observed at all ages (2). All grades of society are subject. Certain families are predisposed. Occurs most frequently in tropics. Is not affected by sex.

Diagnosis. Keloid differs clinically from simple fibroma by elevation above the surface, smooth cicatricial appearance, sharp margin, tendency to form claw-like projections which stand out in relief from the healthy skin, tendency to recur after removal. Morphoea in raised patches may simulate keloid. Morphoea is a circumscribed form of scleroderma. It looks like a piece of old ivory set in the skin. It may be pink, yellow, brown or black. The skin is usually smooth and easily pinched up. It is surrounded by a tinted border of dilated vessels. The ear is not a usual site.

Prognosis. Treatment has been very unsatisfactory. "Excision of entire skin, covering surface with Thiersch's grafts has invariably failed to prevent relapse." The keloid recurs with increased size. Age favors involution and exceptionally spontaneous involution has taken place (1) (2). They usually persist through life. They may remain stationary or slowly increase in size. They do not interfere with the general health.

Treatment. Excision and cauterization are not to be practiced (5). Local applications of iodine, etc., to promote absorption are useless (2). Efforts to relieve by decreasing the vascularity with collodion or pressure have been tried. We are told that electrolysis in very small keloids will sometimes check the growth (1). The generally unsatisfactory results of treatment were shown, however, by the recommendation of Jackson in 1901 in his text-book on Diseases of the Skin, that these growths are best let alone.

Lawrence reported a case in 1898, where after two operations with rapid recurrence, he tried scarification, followed by pressure for several months. This was followed by an apparent cure, when reported, there having been no recurrence in a year (12). Theoretically, this would not seem a desirable method of treatment, and in the absence of further reports can hardly be recommended. Since the development of X-ray treatment, cases have been accumulating that show this to be the most effective treatment yet tried, excepting, perhaps, that of radium rays. The actinic or Finsen rays, however, are reported to exert no influence whatever (21).

The following reported cases outline the results thus far obtained:

Harsha. (15) Keloid removed three times with recurrence larger than ever, under X-ray diminished to 1-6 size.

Ochsner. (20) Keloid under X-ray diminished to slight thickening.

Pancoast. (17) Keloid of lobule and helix of each ear in female mulatto, aged 27. Eighty X-ray treatments 6 to 10 minutes each. Improvement not marked.

Pancoast. (17) Keloid left auricle in colored female, aged 21. Sixty-five treatments X-rays 10 to 15 minutes each. Thiosinamin internally. Patient declared cured.

Pancoast. (17) Keloid right auricle and neck. Treated to prevent recurrence after removal with knife. Increased in size in spite of X-ray.

Boggs. (18) Keloid treated by X-ray 3 times a week for 6 weeks, twice a week for 4 weeks, occasionally for balance of year. Cured.

Williams. (19) Case with two small keloids. One improved under X-rays, the other more rapidly under radium.

Allen. (21) Three cases still under treatment. After thirty X-ray exposures tumors disappearing but not yet cured.

Morris and Dore. (17) Keloid under X-rays. Decided diminution in growth in some cases and marked relief from pain.

Varney. (8) Keloid recurring after three operations for its removal, under X-ray completely disappeared. No recurrence in one year.

Hyde, Montgomery and Ormsby. (9) Five cases keloid-like scar following burn. Decided softening and thinning but not complete disappearance of scar under X-ray.

Morton. (13) Keloid of neck in scar of variola pustule. Recurring promptly after being twice removed with knife; increasing in size to 2 inches long, ¾ inch broad, 1-3 inch high. X-ray three times a week. Thirty treatments. Result, nothing whatever remains of the keloid, the skin is soft and smooth.

Morton. (13) Keloid, length 3 inches, breadth ½ inch, depth ½ inch. Under X-rays for four months, complete cure.

Pusey. (10) Two cases of keloid treated by X-ray. One 2½ inches long, 1¾ inches wide, ½ inch high, nearly disappeared in 11 months. The other diminished ½ under irregular treatments.

Summary. Of 21 cases 5 are reported apparently cured, 14 improved, 1 no marked improvement, 1 grew worse under treatment.

Conclusion. The X-rays afford the best method of treatment for keloid yet demontsrated.

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X.

GROWTH OF BONE IN BOTH TONSILS.*

By William Wesley Carter, A. M., M. D.,
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This case, showing growth of bone in both tonsils, I offer as supplementary to a recent report of a similar case[1] before this section.

These cases are extremely rare, and that two should have come under the observation of one man within such a short period is rather remarkable. A man of 37 applied for treatment in April. He had been suffering with an attack of tonsillitis for five weeks, and said that he had been subject to occasional attacks of much shorter duration than this since he was a child; otherwise he had considered himself healthy and strong. His family history was unimportant. Examination showed the pharynx, and especially the pillars, to be very much congested, the tonsils were moderately swollen and were covered with white specks which seemed to mark the crypts; these specks were confined to the tonsils. Pressure upon the tonsils was very painful, and the patient claimed that he could scarcely swallow even fluids. A smear made from one of these white spots and stained by the Gram method showed the leptothrix buccalis threads and spores in large numbers.

The patient was given an alkaline gargle, and an occasional application of argyrol 25 per cent was made to the tonsils. At the end of two weeks the acute symptoms had subsided, but the distribution of the leptothrix was unchanged. Though the tonsils had receded behind the pillars and were apparently small, there was no doubt about their being thoroughly diseased. I attempted to remove them with the tonsil punch, but found that they were solid masses and could not be included in the grasp of the instrument. I then lifted the right mass from its bed with a small tenaculum and removed it with scissors curved on the flat; the left I removed with the wire snare. Each mass was very much larger than I expected to find it, measuring about four centimeters in length and three centimeters in breadth and thickness. They were completely hidden by the pillars, and were so well accommodated in the tonsillar fossa that I have no doubt that in a cursory examination of the throat, they would have escaped observation. For this reason I am inclined to think that the condition occurs more frequently than the number of reported cases would lead one to believe.

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*Reported at a meeting of the Laryngological Section of the Academy of Medicine.

(1) Medical Record, Feb. 4th, 1905.

The specimens were examined under the microscope by Dr. Wright; both tonsils presented essentially the same appearance. His report is as follows: The horizontal section shows well formed bone with canaliculi and Howship lacunae containing fat and lined with osteoblasts and osteoclasts. There is much fibrous tissue in all parts of the tonsil and very little lymphoid tissue. A number of lacunae lined with keratotic epithelium and filled with keratotic scales are seen, but owing to the action of the decalcifying fluid no threads of leptothrix are distinguishable.

In my former case only one tonsil was involved, and the changes could be traced in the stroma from fibrous tissue through cartilage to bone.

In this instance the changes seem to begin with a keratosis, which is essentially a degeneration, and the bone formation is a later change in the fibrous tissue. The facts in this case go to confirm the conclusions reached in my former presentation of the subject, that bone in the tonsil is a result of retrogressive metaplastic changes in the fibrous tissue carried beyond the usual limits; for not only can the changes be traced to the connective tissue, but its occurrence in both tonsils lends strength to the view that local conditions have nothing to do with it.

It is only necessary to mention that two theories are held to account for this phenomenon. First, that the bone is due to changes in vestigial remains of the second branchial arch, and second, that it is due to metaplastic changes in the connective tissue of the organ.

Here might be mentioned a suggestion made by Dr. Beaman Douglas in the discussion of my last paper, that it might be possible for foreign bodies introduced into the tonsil to act as a nidus for the development of bone. The writer, however, has been unable to find record of any case originating in this way.

In explaining the tendency to the formation of bone in this locality, it is necessary to assume some special predisposing factor. I have not seen it mentioned elsewhere in the literature on this subject, but it has occurred to me that the *saliva* constantly passing over these tissues undergoing metaplastic changes may furnish this factor. About two-thirds of the solid matter in saliva is calcium and magnesium phosphate held weakly in solution by the chlorides of sodium and magnesium. On the other hand, the inorganic matter of bone is chiefly calcium and magnesium phosphate. Now it seems to me that the tonsils undergoing active tissue changes, might the more easily appropriate from the saliva these salts necessary to the formation of bone. If such is not the case, why is it that in the pharyngeal tonsil which undergoes essentially the same changes we never find bone?

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XI.

A CASE OF MASTOIDITIS COMPLICATED WITH EXTRADURAL ABSCESS, WITHOUT A HISTORY OF A DISCHARGE FROM THE AUDITORY MEATUS.

By Samuel Iglauer, M. D.,

CINCINNATI.

Mr. C. G., age 37, restaurant keeper, consulted me September 6, 1905, complaining of pain in and about the left ear. He had always been well, excepting for severe headaches, which he had had a year previous and which had been partly relieved by glasses. The present trouble began seven weeks ago, after rowing, becoming overheated, followed by exposure to the draughts in a trolley car. He has had earache ever since.

According to his positive statement, his ear had never discharged in all this time. His family physician, who has had him under observation for the past three weeks, reports that he has never seen any discharge from the ear. During the first two weeks patient instilled laudanum and sweet oil into his ear. During the past few weeks patient had been treated by poultices and by tincture of iodin painted over the mastoid.

Status praesens.—Patient complains of earache, and of headache referred to the left frontal region and to the vertex. The watch is inaudible; the voice is only heard close to the ear; Weber's test is referred to the left. There is redness and swelling behind the ear; the posterior auricular fold is obliterated; the mastoid is tender. There is a sinking in of the posterior superior wall of the auditory meatus. The ear drum is of a dull red color; bulges; there is no perforation and no pus in the meatus. The temperature is normal and pulse 84.

Diagnosis.—Acute mastoiditis.

Treatment.—Paracentesis was performed and a few drops of creamy pus came through the incision almost immediately.

Ice bags were ordered over the mastoid. The meatus was packed with gauze. Patient returned next day with free discharge of pus, which had saturated the gauze. There was less tenderness over the mastoid. On the following day patient had a slight chill and a slight rise in temperature, the discharge continuing. He was sent to the hospital. The evening before the operation the temperature was 99 3-5°, the pulse 84 and the respiration 20.

Operation.—September 8, 1905, the simple mastoid operation was performed. The cortex of the mastoid process showed a small perforation leading into the mastoid bone. The mastoid cells were not very numerous and were filled with pus and granulations. These were thoroughly removed and the operation apparently completed when a thin streak of pus was noted coming form the posterior portion of the operation canal. The probe was introduced at this point for about one-half inch. The fistula was enlarged, exposing a cavity about the size of a hazelnut, leading directly to the dura mater covering the region of the sinus. The dura was found thickened and covered with granulations so that the sinus was not visible. About a dram of pus was found in the cavity. This, undoubtedly, was an extra-dural abscess covering the sinus at this point. The wound was packed with iodoform gauze and partially closed with sutures.

The pain in the head disappeared almost immediately after operation, and the patient has (November 17, 1905) practically recovered entirely.

This case is interesting owing to the fact that we had a case of acute mastoiditis without perforation of the ear drum, and complicated by extradural abscess. The only symptoms which might have suggested the latter complication were the severe, radiating pain, a slight slowness of cerebration and a certain nervousness which was attributed to loss of sleep.

XII.

A CASE FOR DIAGNOSIS.

By T. H. Farrell, M. D.,

UTICA, N. Y.

The case I present for your consideration is of some interest. I have watched it for over five years without making more than temporary diagnoses. It was seen by Dr. F. A. Bosworth, who made a diagnosis by exclusion of leukoplakia, but the subsequent history does not verify the diagnosis.

A. L. F. Deyo, male, aged 53, a farmer, living on the foothills of the Adirondacks, presented himself for treatment December 18, 1900. A year and a half prior to this he began to have sore throat. Ulcers would appear, heal and reappear. Dr. W. M. Gibson, of Utica, found a trace of sugar in his urine, and treated him for diabetes without result. Five months ago Dr. J. H. Glass, of Utica, diagnosed syphilis and put him on anti-syphilitic treatment, pushing it for four months, when he had lost forty (40) pounds and his throat was still sore. In the last month he has had an attack of shingles. His family and personal history is good.

At the time of my seeing him he complained of his throat being uncomfortable and there was pain in swallowing. On inspection his throat was found to be a good color. The right tonsil was the size of a hazelnut, normal in appearance, except for a small, round, superficial ulcer with a white base and a definite margin with a narrow red border. The left pillars and tonsil were red, the pillars thickened and nodular, the tonsil very hard. On the free edge of the posterior pillar were three superficial ulcers like that on the right tonsil, and on its anterior surface was a clean punched out ulcer without specially red margin. At the junction of the posterior pillar with the soft palate was a yellowish spot as if just ready to break down into an ulcer. The epiglottis was red and swollen with a superficial ulcer on the right side.

December 31st. The ulcer on the right tonsil has spread superficially. The left posterior pillar is more swollen and nodular. The three superficial ulcers are larger than before, the yellow spot has become a superficial ulcer, the deep clean-cut ulcer has healed. Epiglottis looks normal. The right aryepiglottic fold is red and swollen and has a sharply defined depressed ulcer on its posterior surface.

January 3, 1901. The ulcer on the aryepiglottic fold is healed, and the swelling less. The left arytenoid is slightly swollen. The ulcers on the left pillar and right tonsil have spread over a greater area and the tonsil is swollen.

January 11th. Ulcer of right tonsil about the same size. Part of the base consists of a firm, white, closely adherent slough, the removal of which leaves a bleeding surface. Left faucial tonsil and pillars have almost entirely cleared up.

January 17th. Several small white spots have appeared on left posterior pillar and tonsil. These consist of a white elevation rising from a normal mucous membrane—are easily removed and leave a shallow ulcer. A large piece of white slough, which extended deeply into a crypt, in the right tonsil, was removed without bleeding. Slight redness and swelling of the left side of the epiglottis, on which was a small white spot—another white spot at the base of the tongue. Both arytenoids red and swollen. A white spot on processus vocalis of left arytenoid.

January 31st. Larynx and epiglottis look normal. Left faucial pillars and tonsil almost normal. Right tonsil greatly swollen—large, deep ulceration on anterior and posterior surfaces—base tough and white. Right posterior pillar red and swollen. Early in February the patient went to New York and consulted Dr. F. A. Bosworth.

February 19, 1901, Dr. Bosworth writes: I removed the projecting mass on the right tonsil and sent it to the laboratory and had it examined. The report was "Papilloma." This would seem to exclude cancer, lupus and tuberculosis, while Glass' treatment excludes syphilis, it seems to me. My impression at first seeing the case was that it was epithelioma—but there was so little induration that I was doubtful. Accepting the microscopic report, I can make but one diagnosis, "leucoplakia tonsillaris."

You see the obscurity of the case to me, and I merely write the means on which I reached the conclusion.

I have removed all the growth with the snare that I could, and subsequently went over it very carefully with the galvano-cautery.

I have no suggestion to make further than to watch the case and, in case of a return of the disease, to destroy it with the galvano-cautery or some chemical agent.

I have seen a few cases of leukoplakia of the mouth—in which chromic acid did better than anything else. The main danger of this affection is that it may change into epithelioma.

March 5, 1901, Dr. Bosworth writes: I know of nothing that promises better for the patches in Deyo's case than the galvano-cautery. The essential thing is that it be thorough. The prognosis in these cases is rather bad. They return and return in spite of everything—and finally they turn into epithelioma. The best promise of arresting the disease is in the galvano-cautery, and this is because the galvano-cautery does its destructive work more thoroughly than any other destructive agent.

My diagnosis, I think, is correct, and yet it was only by exclusion. It is said that leukoplakia is a mouth disease, and does not appear behind the anterior pillars, and yet considering the history of the case—the microscopic character of the growth, and the appearance—I certainly believe it is the only diagnosis. What else can it be? And it recurs in the characteristic way. I would keep it up with the cautery, and, if you do it deep enough, I believe you will stop it.

June 3, 1901, Mr. Deyo writes: I am very glad I can write you that my throat is completely cleared up. I am satisfied that the soreness came from below where I could not see, and that has now healed, and I feel nothing only a little fullness or swelling, which is fast disappearing. I am working hard—and sometimes in the rain—and weigh 150 pounds in shirt-sleeves.

December 20, 1901. Pharynx and fauces clear and smooth. Epiglottis red and swollen with a deep ulcer on the right side and a shallow ulcer on left side. Cauterized freely with electro-cautery.

January 13, 1902. Epiglottis healed; ulceration in right pyriform fossa. Cauterized thoroughly.

January 19th. Right arytenoid red and swollen; ulcer on superior surface; cauterized with electro-cautery.

January 22, 1902, Dr. Bosworth writes: These cases are exceedingly obstinate and trying, as you observe, and requiring the most active measures. I have never known of such a thing as extension into the larynx, and I doubt if it is a complication to be feared. There is recorded the danger of its developing into epithelioma, but I have never seen any such tendency.

November 26, 1902, Mr. Deyo writes: My throat is behaving beautifully and I scarcely know it is sore at all. Have no trouble about eating (only to get enough), and if it continues to improve as it has done lately I think it will be as good a throat as anybody owns. I think under the circumstances that it will not be necessary to go to see Dr. Bosworth until I can take my diploma (the two years' treatment) with me.

November 18, 1905. Since that time Mr. Deyo has had periods of quiet with no appearance of ulceration or inflammation alternating with periods of exacerbation, involving the posterior pharyngeal wall, epiglottis and aryepiglottic folds. The fauces have remained free.

I wrote to a bureau in Washington for all the literature they could find on leukoplakia in the Surgeon General's Library, and received the following:

LEUKOPLAKIA.

The patches are limited to the buccal cavity, and generally found on dorsum of tongue or inner surface of cheeks and lips, but seldom, if ever, on lower surface of tongue or back of anterior pillars of the fauces. They consist of one or more small irregular or oval spots which may become confluent. A considerable portion of tongue alone may be involved, or dorsum of tongue, buccal mucous membrane and the gums one and all may be affected. The first appearance of the white patch is preceded by hyperemia, and subsequently in the early stages a hyperemic areola is found about its borders. Before long the patch itself becomes thickened, sometimes to the extent of 6-8 m.m., and the epithelium which has become hard and dry may be easily removed, or in spots it may be spontaneously exfoliated, leaving the appearance of an ulcer. The surface of the patch is marked by numerous fine lines or furrows which by intersecting each other divide it into small polygonal spaces.

Excessive smoking is reckoned as a cause.

PROGNOSIS.

The duration of the disease varies from a few months to several years. The majority of cases terminate in epithelioma, which runs its course to a fatal issue.

LEUKOPLAKIA.

Moritz Schmidt, in his text-book, "Die Krankheiten der oberen Luftwege," Berlin, says on page 174: A thickening of the epithelium, leukoplakia oris, occurs not only on tongue, called here leukoplakia linguae, but also on mucous membrane, lips and cheeks in the form of mother-of-pearl spots which generally extend over not a little of the mucous membrane. On surface of tongue occur sometimes only small spots, somewhat deep, which may exhibit the mother-of-pearl color more or less.

On the under-surface occur circumscribed grayish white thickenings of the epithelium, which have the greatest similarity to the gray condylomata of secondary syphilis, with which they are all the more likely to be confused, since it is in syphilis, and after a course of mercurial treatment they are most often found. When these gray spots occur on the tongue only, unaccompanied with appearance in other parts of the body, one cannot, according to my opinion, conclude from this alone that active syphilis exists, entirely apart from the fact that they occur in other chronic irritations of the mucous membrane; for example, in smokers who have never had syphilis.

Schmidt adds: "I would remark also that many persons see in leukoplakia a disposition to cancer. This is a point which the general practitioner is better enabled to clear up than the specialist, as he observes the patient from youth up."

The only literature that I have seen, aside from the meagre notices of leukoplakia in the text-books, is an articles in the Transactions of this Society for 1902 on "Leukoplakia Buccalis, with report of a case treated with X-rays," by Otto J. Stein.

In summing up he says: "The appearance of the disease as usually first recognized is that of pearly-white or milk-white irregular plaques or patches of varying size, smooth and glistening, causing no discomfort whatsoever, appearing anywhere on the mucous membrane of the cheeks, lips, gums, tongue, palate and fauces. Later they become more thickened and hence elevated ; also, more hardened until they may present a rough and pitted surface, hornified to the feel and markedly elevated. Either one of these two conditions may begin to fissure and finally ulcerate, resulting in a very painful affection."

This is very different from the condition in Deyo's throat. Here the disease did not pass in front of the anterior pillars. The ulcers were preceded by small yellow spots under the surface, or by small white tufts, which were soon thrown off. A peculiarity of the disease is, that while apparently perfect healing takes place in one locality, it breaks out in another not contiguous. He has had long intervals when no evidence of the disease could be seen.

The only treatment that has been of any use, is that suggested by Dr. Bosworth of thorough cauterization, and the more thoroughly it is done the more promptly the healing process.

The patient is here for your inspection and diagnosis.

In discussion, Dr. Theisen of Albany, and Dr. McCaw of Watertown, suggested that it might be a case of Vincent's angina.

XIII.

MUELLER'S VERTICAL NASAL CUT.

By Frank B. Seitz, M. D.,

BUFFALO, N. Y.

Killian's muco-perichondrial elevation and extraction of deflected cartilage and Ballenger's swivel knife have given an impetus to and aided in the perfection of deflected septal operations. We have the Chiari, Hajek, Killian, Ashe and other incisions, but they are used only on deflected nasal septi. The straightening of the nose seems, however, to have escaped especial mention; for I have noticed particularly at the Buffalo meeting that speakers spent their energies on the septum. We should remember that there is a difference between a deflected septum and a deflected nose. Each may exist independently and also together. It is not my intention to add anything original, but to call attention to a valuable adjuvant which already exists, but seems to be overlooked as unimportant. It is the vertical cut in the septum for straightening a nose.

While taking a rhinologic course with Dr. Mueller at Vienna, he casually told the class of a vertical line of interrupted incisions into the cartilage of the septum from the tip of the nasal bones to the floor of the nose. He gave it to the class without any ostentation or claim to originality, gave it as if it were a well-known and common incision; in fact, he did not mention who first used it.

The Mueller cut—I will call it that for want of a better name—consists essentially of slight incisions through the cartilage of the septum running in an interrupted vertical line downward from the nasal bone. The cuts or stabs are made by inserting a curved bistoury inside of the nostril and engaging the cartilage up close to the lower edge of the nasal bone. The tip of the knife is then pushed through and withdrawn, leaving a wound the width of the knife. Now lower the knife about one-eighth of an inch and make another similar stab through the cartilage. Continue down in a straight line to where the raphé joins the upper lip. The unincised intervals serve to keep up circulation and hasten healing. The nose can now be bent over like a door swinging on a hinge, and can be placed so that its tip will be in a line with the V in the upper lip and a point midway between the eyebrows.

The splint to keep the nose in place is probably well known, but may be recalled here to finish the article. A splint may be made of wood—from a cigar box—one-quarter inch thick, three-fourths inch wide and two inches long, or of a size and shape to fit the nostril. The split can be sterilized, wrapped in bichloride gauze to make it of sufficient thickness to remain in place. It is now pushed into the nostril, allowing about one-half inch to project. It must be placed in the nostril on the side toward which the nose formerly had turned. Now make a hole in a piece of one-inch wide adhesive plaster to engage the projecting end of the splint, draw the nose into a straight line by means of the strip of adhesive plaster attached to the splint and stick the plaster across the cheek to below the ear. If no untoward symptoms arise, the dressing can be left undisturbed from four to six days.

This vertical cut and procedure may be known and practiced by many. I am sure it is used by members of my class at Vienna; but I am equally sure that as it has not been mentioned in discussions and articles, it is not known to many others. It is to reach the latter class that I venture to bring up what may seem to be an old subject.

21 North Street.

XIV.

THE INDICATIONS FOR OPERATING IN ACUTE MASTOIDITIS.

By Philip D. Kerrison, M. D.

NEW YORK.

In determining the relation of surgery to disease, one should deduce one's facts from the cases which have recovered without operation, as well as from those operated upon. Particularly does this seem to be true with regard to the *indications for operating in acute* mastoiditis.

Competent surgeons, usually at one theoretically, often differ materially in practice. Whoever, therefore, feels called upon to dissent even in the smallest particular from the popular conception of what should constitute an indication for opening the mastoid, should have the courage to state his views and give his reason therefore. It is the relative surgical value of what are commonly considered the two cardinal physical signs of acute mastoiditis that the writer wishes to discuss.

To review briefly the symptoms of acute mastoiditis, they may be stated somewhat as follows:

The patient during the course of, or convalescence from, an attack of acute purulent otitis media, may suddenly experience deep seated pain in the region of the mastoid process.

The aural discharge, which has perhaps been gradually decreasing in quantity, may follow one of several courses in order to show that recovery has been interrupted; e. g., it may (a) suddenly cease, this abrupt cessation being accompanied by no amelioration of the patient's condition, and being followed within a few hours or a few days by a still more copious flow of pus; or (b) the discharge may gradually increase in volume until it becomes necessary upon purely physical grounds to assume the involvement of accessory sinuses in order to explain the quantity of pus excreted during the twenty-four hours; or (c) the long continuance of the discharge may of itself be sufficient to warrant the inference of a necrotic focus more deeply seated than within the small tympanic cavity. With the appearance of mastoid pain, sleep is disturbed, insomnia becoming a more or less prominent symptom; and the temperature, which has run a normal course, or has returned to normal, may become elevated. As corroborating the above symptoms, the two following physical signs have come to be regarded as pathognomonic, viz: (1) Tenderness on pressure over the mastoid; and (2) bulging of that portion of the postero-superior canal wall which immediately adjoins the drum-membrane.

The symptoms to be looked for, then, are *mastoid pain,* with consequent insomnia; *elevation of the temperature; certain quantitative changes in the character of the discharge; mastoid tenderness, and bulging of the postero-superior canal wall.*

The above rather meager clinical picture may be said to comprise practically all the symptoms that are characteristic of an uncomplicated case of acute mastoiditis.

Unfortunately many cases of acute mastoiditis run their course with complete absence of one or more of the above symptoms. That extensive necrosis of the mastoid cells may occur with absolutely no elevation of temperature is a fact now fortunately recognized. Mastoid pain may also be absent, or at least not sufficiently marked to be complained of by the patient. When fever is absent, and pain inconsiderable, the subjective and constitutional phenomena are naturally not very characteristic. Fortunately there is one physical sign which is never wholly absent. Sensitiveness to pressure is probably at the onset always present over some point on the mastoid cortex.

In discussing the surgical value of the two physical signs above mentioned, it will be necessary to refer very briefly to certain points in the anatomy of the bone which bear more or less directly upon the pathology of the disease.

Pain on Pressure Over the Mastoid Antrum.—If we were taught to regard the antrum, not as one of the mastoid cells, but simply as the posterior end of the tympanic vault, our conception of its true surgical significance would be more exact. In the fetus at term, the mastoid process as such does not exist, it being represented by a thin cartilaginous plate; yet the antrum is already an easily demonstrable cavity. In the seventh month of fetal life, also, the antrum can be demonstrated to exist, and at this period of its development, its walls are formed chiefly by the squamous portion of the future bone. While these facts are now fairly generally recognized by students of tympanic anatomy, their surgical significance is still somewhat obscured by statements in some of the older text-books which refer to the antrum as one of the mastoid cells, and describe the *aditus ad antrum* as a narrow passage by which it communicates with the tympanic vault.

The aditus is not a narrow passage connecting two bony cavities. It is distinctly a constricted portion of one and the same cavity. Careful examination of a large number of bone sections shows the aditus to consist of a comparatively large triangular space, the vertical diameter of which—i. e. measured from the centre of its base above to its inferior angle below—will average not less than 4 to 5 mm. Considered as one osseous space, the antro-tympanic cavity may be described as one having a central constriction, and so bent upon itself that while its roof lies throughout in the same horizontal plane, its floor is lower anteriorly and posteriorly than at the center where encroached upon by the lower margin of the aditus.

The antrum, then, should not be thought of as a distinct bony cavity; nor is it an accessory sinus in the sense that the frontal, ethmoidal, sphenoidal and maxillary cavities are accessory nasal sinuses. For whereas hypersecretion may occur, and frequently does occur, within the nose without flooding these accessory cavities, it is difficult to conceive of any considerable accumulation of fluid within the tympanic vault which will not flow backward into the antrum.

This rather tedious statement of facts prepares the way for the following propositions, viz: (1) *That acute purulent otitis media is probably always attended by an escape of pus into the antrum; and* (2) *That the presence of pus within the antrum is not necessarily an indication of mastoid inflammation.*

These conclusions seem fairly deducible from the mechanical relations of the various parts of the antro-tympanic cavity; and from certain clinical facts now generally recognized. In the living subject the vault is more or less completely separated from the lower portion of the tympanic cavity by the following structures; viz: the neck and processus foliamus of the malleus, the lower angle of the body of the incus; the anterior, posterior and external ligaments of the malleus, and the folds of mucous membrane covering them. With these structures in situ, it would seem more reasonable to assume the mechanical separation of the atrium and vault, than to recognize the vault and antrum as two distinct cavities. Pus in the vault, therefore, must under pressure pass in the direction of least resistance to the antrum.

Now experience has shown that in the majority of cases of severe tympanic infection, the suppurative process originates within the vault rather than the atrium, in which case it seems obvious that pus accumulating within the vault must quickly invade the antrum. The fact, therefore, that many cases of severe suppurative otitis media recover without having produced any symptoms of mastoid involvement would seem sufficient evidence that pus within the antrum may be reabsorbed without having produced any of the bone changes characteristic of a true mastoiditis.

To epitomize: *Acute purulent otitis media is commonly accompanied by the passage of pus to the antrum; and its presence there on opening the antrum is not necessarily an evidence of mastoid inflammation.*

Admitting the above as a working hypothesis, it is not surprising that marked sensitiveness to pressure over the antrum is present in many cases of acute purulent otitis media. With an acute inflammatory process involving the mucous membrane not only of the attic but also of the aditus and antrum, and with the whole antro-tympanic cavity subjected to the pressure of an accumulation of pus for which there is no adequate orifice of escape, absence of pressure tenderness over the antrum would mean a difference between this and all other regions of the body under like conditions. In other words, antrum tenderness may in such cases denote simply the presence of confined pus. Viewed in this way, this important danger signal is as much a logical outcome of the tympanic lesion as is its rapid subsidence a logical result of free incision of Schrapnell's membrane and other rational measures for the relief of an acute purulent otitis media.

Where antrum tenderness persists in spite of such abortive measures, its significance must of necessity be regarded as more grave.

Pressure Tenderness Over the Mastoid Cells Proper.—In the foregoing remarks, the writer refers only to that stage of the disease in which inflammatory process is confined within the limits of the antro-tympanic cavity. When the pus has found its way into the mastoid cells proper, the disease is by no means so likely to yield to the simpler surgical and therapeutic measures. The lining membrane of the cells in the lower portion of the mastoid process seems to possess but little power of resistance to the action of infective organisms, and their intracellular bone substance is exceedingly prone to undergo necrosis. The significance of mastoid tenderness must, therefore, vary somewhat with its location upon the mastoid cortex, its gravity becoming relatively greater as it extends downward below the level of the floor of the antrum.

Sagging of the Posterior Canal Wall.—A question which it may be permissible to reopen is the surgical significance of *sagging* or, better stated, of *bulging downward and forward of the postero-superior canal wall.* Are we to continue to regard this as one of the cardinal signs of mastoid inflammation? Is the periostitis upon which this bulging depends due to an extension of mastoid inflammation through that portion of the thick anterior wall of the mastoid process whch enters into the formation of the posterior canal wall? Or is it rather an extension of inflammation by continuity of structure along the soft parts of the posterior canal wall from the tympanic vault? The writer believes that in the vast majority of cases this bulging of the postero-superior canal wall is due to an extension of inflammation from the vault, and is not an indication of mastoid inflammation, which may or may not be present. This belief is based upon the following anatomical, surgical, and clinical facts:

(1) *Anatomical.*—(a) A section of the temporal bone, more or less horizontal in direction, and passing through the postero-superior canal wall, shows this to consist of a dense, and often thick plate of bone which should act as a natural barrier to the rapid extension of an inflammatory process from the mastoid cells to the membranous lining of the bony canal. (b) The intimate structural relation of Schrapnell's membrane to the membranous lining of the posterior canal wall provides a natural pathway for the extension of inflammation by continuity of structure.

(2) *Surgical.*—While complete removal of all diseased bone is the first aim of mastoid surgery, this indication never in acute mastoiditis requires the removal of any portion of the bony plate which separates the mastoid cells from the membranous canal. In other words, the posterior bony wall is rarely if ever diseased. Why then, if this bony partition is not

involved in acute mastoiditis, should swelling of the membranous lining of the posterior canal wall be regarded as an evidence of mastoid inflammation.

(3) *Clinical.*—(a) In cases of *chronic suppurative otitis media* in which extensive destruction of the membrana tympani has occurred, characteristic bulging of the posterior canal wall is never present; yet in such cases the posterior wall of the bony canal as well as the mastoid cells, is often diseased. How is the absence of this physical sign to be explained except by the loss of continuity between the structures of the vault and those of the membranous lining of the meatus?*

(b) There have been many cases of *acute purulent otitis media* which in spite of marked bulging of the postero-superior canal wall, have recovered completely and permanently without having produced any marked signs of mastoid inflammation. Such cases have been repeatedly observed by others as well as by the writer.

Two facts, then, should be borne in mind, viz: (1) that this "sagging of the posterior-superior canal wall," whatever the exciting cause, is the result of inflammatory changes in its periosteal lining; i. e. is dependent upon a true periostitis; and (2) that in no structure of the body is swelling due to acute inflammation more likely to be prolonged than in the periostea. This is a recognized surgical fact. If, therefore, a somewhat protracted inflammatory thickening of the postero-superior canal wall be regarded as an evidence per se of an acute mastoiditis, many cases may be operated upon in which mastoid inflammation has either never existed, or having been present, has undergone resolution.

The writer wishes to emphasize the fact that not every case of acute purulent otitis media which developes antrum tenderness and bulging of the posterior canal wall is necessarily one of true mastoiditis; and that between the milder grades of tympanic infection and inflammation of the mastoid cells proper there is an intermediate condition—an empyema of the antro-tympanic cavity, which yields quite happily to free incision of the drum-membrance and appropriate after measures. Antrum tenderness may mean, therefore, either a collection of pus in the antro-tympanic cavity, or the early stages of a suppurative process within the mastoid cells. Which of these two conditions exists can be determined only by the manner in which the symptoms respond to treatment; i. e. their persistence or rapid disappearance after free incision of the drum-membrane and inflamed posterior wall. It is to be noted, however, that even in those cases which go on to rapid and complete recovery, the "sagging of the posterior canal wall" is one of the last symptoms to disappear.

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*In cases of chronic suppurative otitis media in which the upper half of the drum-membrane remains intact, exaccerbations of acute inflammation not infrequently give rise to characteristic bulging of the posterior wall.

The indications for operating in acute mastoiditis may be summed up somewhat as follows:

(a) Sudden cessation of the aural discharge, other symptoms persisting; deep seated pain in the mastoid region; marked sensitiveness to pressure upon the mastoid *over an area extending well beyond the limits of the antrum;* these symptoms in the presence of a sudden and considerable rise in temperature, would justify an immediate operation.

(b) In the absence of fever the above symtoms, unless yielding promptly, i. e., in 24 to 48 hours, to abortive measures, would constitute a sufficient reason for operating upon the mastoid.

(c) Marked tenderness over the antrum, *persisting four to five days after free incision of Schrapnell's membrane,* would point to necrotic changes within the antrum calling for operative intervention.

(d) Marked variations in the quantity of pus discharged; its maximum flow being apparently too great to be explained by the tympanic lesion; its periods of diminution being co-incident with the development of mastoid pain or tenderness (or both). Such a combination of symptoms constitutes one of the most positive indications for opening the mastoid.

(e) Mastoid tenderness having been present and having disappeared, a discharge from the tympanic vault which resists all rational non-operative measures, may by reason of its persistance justify the hypothesis of a necrotic area in the aditus or antrum. In such cases an operation is often the only means of saving the integrity of the organ, and preventing serious impairment of function.

(f) Finally, evidences of mastoid involvement having been present, the development at any time during convalescence of symptoms of septic absorbtion, e. g., septic temperature, constitutional exhaustion, etc., would in the absence of other concurrent diseases, constitute a positive indication for immediate operation.

It will be seen from the above that the writer recognizes a number of conditions as calling more or less imperatively for operative intervention. He is convinced, however, that a careful observance of the rule implied in the third clause, ("c") will reduce very materially the number of cases requiring operation. That is to say, where tenderness is confined to the antrum and free drainage through the drum-membrane has been established, a delay of 4 to 5 days will in many cases demonstrate clearly the absence of mastoid disease

Among the "indications for operating" the writer has not included *bulging of the postero-superior canal wall,* because he believes this to be a physical sign of *acute suppurative otitis media.* It is of undoubted surgical value in pointing to a type, or perhaps stage, of tympanic infection, which must receive prompt and vigorous treatment in order to prevent an extension of the disease to the mastoid cells. Its persistence, however, after mastoid tenderness and other signs of mastoid involvement have disappeared, is no indication of mastoid disease, and should not be regarded as an indication for operative intervention.

N. B.—The writer has purposely avoided any allusion to the bacterial character of the discharge as influencing prognosis and treatment. Cases of streptococcus infection often yield quite readily to minor surgical measures, whereas others in which only the milder pus germs are found often prove most severe clinically. Until we can explain, therefore, the varying degree of virulence exhibited in different cases by apparently the same germ, it would seem safer that the question of operation should be decided in each case chiefly by reference to the symptoms and physical signs.

In conclusion the writer would like to cite two cases from his own practice:

Case 1. A. D., a girl 8 years of age, was referred to the writer on January 15th, 1904, by Dr. Howard Gillespie Myers.

Previous history: Measles 2 years ago, no aural sequelae. Has been subject during past two years to somewhat frequent attacks of acute tonsillitis. Breathes normally.

Present attack. On January 5th, developed acute tonsillitis. On the following day, complained of pain in left ear, which persisted more or less constantly until January 10th, when relieved by spontaneous rupture of drum-membrane. 5 days later, symptoms recurring, I was called in.

At this time, child complained of ear-ache. Temperature 101.6 degrees.

Physical Examination. Whole drum-membrane is red, with pronounced bulging of Schrapnell's membrane; the bulging here is continuous with marked swelling of the soft parts covering the postero-superior wall of the bony canal. Small perforation in postero-inferior quadrant of mt. Marked tenderness *over mastoid antrum.*

Treatment. Under nitrous oxide anesthesia, the drum-membrane was freely incised — the incision being carried through the posterior segment of the tense membrane, through Schrapnell's membrane into the vault, and thence outward through the inflamed posterior wall. Leiter coil applied to mastoid. Irrigation of canal with bichlorid of mercury 1 in 5,000, ordered q. 3h. Leiter coil removed at the end of 24 hours, and not replaced in spite of the fact that antrum tenderness was still present. From this time the tenderness over the antrum became daily less marked and had entirely disappeared on January 19th, the 4th day after the myringotomy. Other symptoms were much more persistent. The discharge showed but little tendency to diminish. On January 23rd the incision in the drum-membrane having partially closed and drainage being obviously insufficient, the original incision was repeated. Shortly after this, in spite of a rather free discharge, it was thought wise to discontinue irrigation, and substitute the use of dry wicks of sterile gauze carried into the canal and against the opening in the drum-membrane, both of which had been previously cleansed and dried. The wicks were changed at first twice, and then once daily. From this time the symptoms showed gradual but satisfactory improvement. *The persistent sagging of the postero-superior canal wall, however, was a cause of doubt and anxiety to the writer.* Even after the opening in the drum-membrane was closed, and the tense membrane had regained a fairly normal appearance, the swelling of the posterior wall was marked. All other symptoms having disappeared, the writer felt justified in discharging the patient on Feb. 11th, the parents being instructed to report promptly any symptoms of relapse.

Three weeks later, the patient was brought to the office for examination. There had been no recurrence of aural symptoms. The tense membrane was normal in appearance. Function tested by acumeter and whisper, seemed perfect. The postero-superior wall, however, still showed some thickening. The writer has heard indirectly that there has been no return of symptoms referable to the ear.

Case No. 2. Mrs. D., was referred to the writer on Feb. 17th, 1904, by Dr. S. A. Brown.

Previous history negative.

One week ago, as a sequence of acute rhinitis, patient experienced severe pain in right ear, which was relieved in a few hours, by spontaneous rupture of drum-membrane. The patient is referred to me on account of continued discharge and return of pain. Temperature 102 degrees.

Examination of right ear. Small perforation in postero-inferior quadrant of mt. Schrapnell's membrane bulging, there being no line of demarkation between this and the swollen postero-superior canal wall. Marked tenderness on pressure over antrum.

Treatment. Under nitrous oxid anesthesia the posterior segment of the drum-membrane and the inflamed posterior wall were freely incised. The usual measure, i. e., rest in bed; catharsis: irrigation q. 3. h. with bichlorid of mercury, 1 in 5,000 solution, were ordered. Patient advised that mastoid operation might be necessary. She was seen daily. Discharge at first free, diminishing daily. On February 22nd, antrum tenderness was barely appreciable on deep pressure. One week later the incision in the drum-membrane was completely closed. The swelling of the posterior canal wall, however, had not subsided, and was again a cause of anxiety to the writer, who still shared the popular belief as to its grave surgical significance. This anxiety the patient did not share. She was free from pain, and to all intents in her usual health, and but for a slight impairment of hearing, would probably have regarded her cure as complete. The correctness of this view was demonstrated by the complete subsidence of all symptoms, the inflammatory changes in the posterior canal wall being the last to disappear.

These histories might easily be reinforced by others in which the disease ran a similar course. They suffice, however, to illustrate clinical phenomena, which the writer has observed in a very considerable number of cases. They were selected chiefly because, having occurred considerably over a year ago, sufficient time has elapsed to justify the conclusion that recovery was complete.

DISCUSSION.

Dr. Edward B. Dench, of New York, said the distinction attempted by Dr. Kerrison regarding the aditus ad antrum as connecting the tympanic vault and the mastoid antrum was analogous to whether we called a strait a narrow neck of water connecting two larger bodies, or a constriction of a large body of water. He did not regard the distinction as material.

According to Dr. Kerrison, tenderness over the lower cells was more important, as a diagnostic sign, than tenderness over the antrum. Dr. Dench said that in the past four or five years, in almost every case of acute otitis, especially those complicating grippe, there was tenderness over the lower mastoid cells and none over the antrum until well marked changes in the antrum had taken place. Whenever there was mastoid tenderness, it could always be looked upon as a sign of inflammation. The speaker said he had seen caries of the cells in the posterior wall of the canal occur very early in acute mastoiditis. Its occurrence there depended on the conformation of the cells in the mastoid, as in some cases the posterior wall of the canal was very thick. The posterior wall of the canal was simply the anterior mastoid wall, and it was very frequently affected in acute disease. The speaker said he could recall a number of cases in which the only symptom of mastoiditis was a sinking of the upper, posterior wall of the auditory canal. Clinically, he regarded this as one of the strongest signs that the mastoid was not draining satisfactorily.

Dr. S. MacCuen Smith, of Philadelphia, said that of all the symptoms of mastoid disease, he placed most reliance upon bulging of the posterior wall of the auditory canal. He had never yet seen that sign fail. He did not mean to imply, however, that bulging of the posterior and superior walls was an invariable symptom of mastoid disease, nor would he operate on the strength of that sign alone, although he regarded it as very important. In a case that recently came under his observation, the patient was a child one year old, the daughter of a physician. That child had never had any ear trouble, had never had any discharge, and had never lost any sleep. One morning, the nurse observed a slight swelling back of the ear, over the mastoid. An examination through the external auditory canal failed to reveal the slightest redness, but there was distinct bulging of the posterior and superior walls, with characteristic redness. The case was operated on the same morning, and to his surprise he found a carious opening through the cortex; the antrum and the mastoid cells were filled with pus.

Dr. J. A. Stucky, of Lexington, Ky., said that while sagging of the posterior superior wall of the canal might be pathognomonic of mastoid involvement, still the reverse was not necessarily true. We might have very extensive involvement of the mastoid cells, with absolutely no abnormal indication of it in the posterior superior wall. The speaker said he had seen several such cases, in which there was a history of ear discharge lasting some weeks, and no bulging of the superior wall at all. The ear in those cases was apparently draining well, but the patients had a septic look and ran a septic temperature, and on deep pressure there were signs of mastoid involvement. In one such case where the patient was operated on, Dr. Stucky said he was amazed at the extensive destruction of bony tissue.

The speaker said that in the section of the country where he came from there was still much room for missionary work among the general practitioners, and even among the otologists. Many of these still waited for this bulging of the posterior superior wall, and he could recall two instances where they waited too long. In both of those cases the patients developed meningitis, and died.

Dr. L. L. Mial, of New York, said that in connection with this subject of mastoid tenderness, as indicative of mastoid inflammation, he wished to mention two cases that came under his observation during the past six months. One was that of a man 23 years old who complained of severe pain in the ear and mastoid. There was excruciating tenderness over the tip of the mastoid, but no bulging or other indications of mastoid trouble. It was finally discovered that he had a badly decayed tooth on the lower jaw of that side, and when this was extracted, all his symptoms disappeared. The second case was that of a child of fourteen years, in which a similar train of symptoms was traced to the same cause.

Dr. Francis R. Packard, of Philadelphia, said that bulging of the wall of the canal was a particularly valuable symptom in cases where there was no discharge. He recalled such a case in which he was called upon to operate by Dr. A. W. Watson, of Philadelphia. There was no discharge, but on opening the mastoid, it was found to be rotten, and every cell was filed with pus. It was in this class of cases that the bulging was particularly valuable, as it indicated that the pus was penned in and could not get out.

Dr. Edward B. Dench, of New York, said that if the mastoid tenderness persisted for four or five days, he would be inclined to operate. The tenderness very frequently began at the tip of the mastoid, and spread up to the antrum, and it was this last tenderness that was important.

Dr. Philip D. Kerrison, in closing, in reply to Dr. Dench's statement that he had seen necrosis of the bony wall, said he did not see any reason why that should not occur in cases where the process went on to distinct mastoiditis. Personally, he had never seen it. In his paper, he had tried to bring out the point emphasized by Dr. Dench, namely, that bulging of the posterior wall was the very best sign we had that drainage was not perfect. Dr. Kerrison believed that it was an important sign of severe tympanic infection, but did not necessarily point to mastoid inflammation.

In the case reported by Dr. S. MacCuen Smith, the doctor had stated that there was some swelling behind the ear, which everyone agreed was an absolute indication for immediate operation. In Dr. Smith's case, this post-auricular swelling was stated to have been present some days before the sagging of the posterior canal wall was noticed.

Dr. Kerrison said that while much had been written regarding antral tenderness and bulging of the canal as pathognomonic signs indicating operation, he could recall a large number of cases where both those signs were present and disappeared, and the patients made a perfect recovery without operation.

XV.

REPORT OF SEVEN INTRACRANIAL OPERATIONS WITHIN A YEAR.

By George F. Cott, M. D.

BUFFALO.

Since the advent of grippe some fifteen years ago, many more pus cases affecting the middle ear and sinuses such as the antrum of Highmore, frontal, ethmoidal, and sphenoidal, have been reported than before that time. The ear cases occurring during an attack of so-called grippe are sometimes very intractable and yet the influenza bacillus is seldom found. This is explained by claiming that after an acute attack of influenza the mucous membrane is left in a more or less susceptible condition to irritating substances and thereby becomes fertile soil for the various cocci.

The cases which I report to-day, seven in number, all requiring intracranial manipulation during 1904, dated far beyond this period, save one, and therefore could not be counted as caused by that virulent poison.

The histories of the several cases were traced back to early childhood, all of which had been treated at different times for indefinite periods.

Whenever symptoms of severe deep-seated pain were present intracranial involvement was looked for, but if no opening in the roof of the tympanum was found and no other symptoms but pain observed the radical operation alone was done and further developments awaited. When the dura or brain were involved this became manifest sooner or later, when further operative procedure was undertaken. To differentiate between neurosis and true symptoms of meningeal affection was sometimes very difficult and would cause the patient prolonged suffering until another operation seemed justified. Over-enthusiasm for operating must be discouraged, while on the other hand extreme conservatism often leads to grave disaster. The following cases are self-explanatory:

Case 1—*Pachymeningitis with Extradural Abscess*—

Man aged 30, had been confined to bed several weeks and unable to work for six weeks because of severe pain in the ear; no discharge, but gave a history of chronic suppuration in childhood which had stopped years ago. Diagnosis of pachymeningitis and perhaps pus under dura was made and he was sent to Riverside Hospital for operation. After having inhaled a small quantity of chloroform and before the post aural incision was made, patient's breathing gradually became shallow until it ceased altogether; pulse could not be felt at the wrist nor the heart sounds heard over the chest. The table was quickly tilted head downwards and artificial respiration performed until I was too tired to continue, when the assistant, Dr. Jones, worked over him until he gave up and I resumed work again; finally our efforts were crowned with success and patient made slight efforts to breathe, which became more and more pronounced until breathing was again regular.

The radical operation was then proceeded with. The suppuration in early life did not last long enough to cause sclerosis as we usually find it, for the lower cells were quite brittle, the deeper part of the bone having become particularly softened. After its completion the roof of the tympanum was chiseled away and the upper part of the bony canal. Pus was found under the dura, which membrane was very decidedly thickened.

While cleaning out the cells, the internal wall of the mastoid process was found destroyed, leaving a circular opening about five-eighths of an inch in diameter.

The whole cavity was packed wth gauze and patient made an uninterrupted recovery. The ear became dry in six weeks.

Case 2—*Septic Sinus Thrombosis with Epidural Abscess*—

Benedict Scynowski, age 12, U. S., of Polish parents. Father and mother, four brothers and two sisters healthy. Boy was never sick until three weeks before; had severe headache which for the most part was confined to the supraorbital region and was constant. On January 1, '04, ear began to discharge. Entered Deaconess Hospital on January 20, with a temperature of 104 and pulse 130. He was treated for two weeks before for typhoid fever, when a change of doctors was made. Dr. Bradley L. Door, under whose care he had come, asked me to see the patient and be prepared to open the mastoid. I was somewhat late and the doctor had incised the periosteal abscess and evacuated a quantity of pus. The patient did not improve much. I was asked to see him again on January 23rd; the temperature was then taken every four hours; if no improvement took place in one or two days another operation would certainly be necessary. January 25th, being satisfied there were intracranial complications, and having explained the seriousness of the boy's condition to the mother, that he certainly would die without operation but had a chance, although a slim one, with it, she consented. A radical operation was first done; although there was no history of previous ear disease, sufficient evidence was found showing old suppuration such sclerosis, remnants of drum-head and ossicles. During the chiseling, pus was noticed coming through the roof of the tympanum; a large opening was made, when a quantity of pus was found under the dura. The result did not satisfy me, however, for the temperature indicated involvement of a sinus, presumably the lateral or sigmoid. The skull was opened over the lateral sinus, which was found apparently empty. A sharp spoon was introduced toward the torcular herophyli and the sigmoid knee and a small quantity of pus brought away each time, then pieces of the thrombus were removed until blood flowed from both sources. The sinus was then packed with gauze and the wound dressed in the usual way. The boy was in pretty bad shape after the operation; strychnia and salt solution were injected and hot bottles applied. He rallied nicely, had a fairly good night, but died the next day. Postmortem examination was not permitted. Although the case was treated as typhoid fever because of the peculiar temperature, still the extremes, with discharge from the meatus and the bulging of the ear with pain radiating over the right side of the head should have at once cleared up the case as showing that there was intracranial mischief.

The following urinalysis, single sample, was by Dr. Schwertfeger:

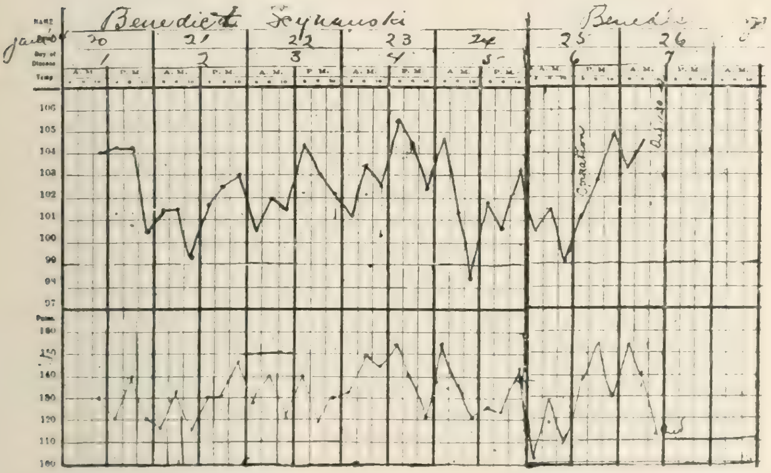
Color	amber.
Reaction	acid.
Odor	urinous.
S. G.	1010.
Sediment	absent.

Albumin ....absent.
Sugar ....absent.
Microscopic ....epithelium and urates.
Ehrlichs diazo test.......................negative.

History After Entering the Hospital—

The first night at the hospital the patient rested quietly and slept some, had a good movement, and vomited several times; Epsom salts given, but vomited. On the 21st of January Dr. Dorr evacuated the abscess behind the ear without much pain.

Following is the temperature chart:



Bowels moved twice that day, brown fluid. At night, no sleep, delirious at times. On the 22nd stool was light brown, containing white curds, followed by three more brown fluid movements; at night sleep at intervals. Next night more quiet but was delirious at intervals. Although quiet during the day time, no sleep at night. On the 25th he slept some and rested quite well after 2 a. m. The night after the operation he was given hypodermically strych., digitalin, nitroglycerine and whisky, also eight ounces of saline solution; he had a pretty good night and slept at intervals, but died at 11:30 a. m.

Case 3—Dura Attached to Roof of External Canal by Fibrous Band—

Mrs. S., age 38, height a little over five feet, weight 230 pounds; case referred by Dr. Jas. E. King. Had discharge from left ear for many years until seven years ago. Uterus curetted two years ago; since then ear discharged again, which she attributes to the anesthetic. Severe pain over side of head, also deep seated. Treatment of no avail. Radical operation March 3rd, 1903; drumhead and ossicles absent. After this ear was more or less dry, but pain continued and at times became unbearable; occasionally wanders around until found and taken home, all due to the tremendous pain, she claims. Patient was markedly neurotic and for that reason a second operation was deferred; she, however, insisted upon having something done, so on August 10, 1904, 17 months after the radical, the old wound was opened again and sufficient bone of the skull removed to lay bare the dura for three-fourths of an inch; at the roof of the canal a very strong fibrous band was found attached to the dura and the bone which could not be torn from its attachment but had to be cut out with scissors; otherwise the appearance seemed healthy. The wound was then closed and the exposed dura packed with idoform gauze. The patient has improved perceptibly but is by no means well. At the present writing the ear is dry but there continues occasional pain as before the operation, but her general condition is very much improved.

Case 4—

Mrs. Dr. B., age 51, case referred by Dr. Geo. E. Fell; chronic middle ear suppuration for many years, with pain in ear and radiating over side of head, causing months of sleepless nights and consequently a marked neurotic condition. The radical operation was undertaken, followed by some amelioration, but gradually the pain again became unbearable. Discharge from the cavity never ceased. Hour glass contraction quite external to site of drum head emitting drops of fetid pus. Several months later, patient seemed as bad as ever, but because of her neurotic condition further interference was postponed until finally, several months after the first operation, the patient was again removed to the Buffalo General Hospital on account of a probable pachymeningitis. The old wound was reopened, some tough tissue and half an inch of the roof of the external canal removed. The dura was coated with organized lymph and the roof markedly roughened, all of which was curetted and the opening packed with gauze. Patient made an uninterrupted recovery and although some pain still remains, she is very much better and able to perform her duties as the mother of eight children, takes things philosophically and has withal a happy disposition. The scalp is still sore to the touch.

Case 5—Sinus in Temporal Lobe—

Mrs. B., age 44, strong, robust and well built, had discharge from left ear about forty years. Called on me for relief, having had severe pain lately. I found carious bone wherever the probe could reach, no vestige of ossicles or drum head left; treated her some months without entirely stopping the discharge or relieving the fetid odor permanently. Operation was advised but stoutly refused until a year after treatment had begun, then her headaches became so severe that she lost considerable sleep and finally consented to go to the Deaconess Hospital, where a radical operation was done; before closing the postaural wound the bone was probed to seek a cause for the severe headaches; at one point the probe entered the skull over the tympanum; bone was chiseled away sufficiently to explore and then a hole nearly one-eighth of an inch in diameter was discovered in the dura; a probe passed through it which entered the temporal lobe one and one-quarter inches. An incision was made along the sinus large enough to easily admit a sharp spoon, the sinus curetted and then packed with iodoform gauze. After three days the gauze was removed and the opening repacked. At the end of two weeks the wound in the brain was allowed to heal and the external wound closed with sttches. Patient made an uninterrupted recovery. Now, four months after operation, patient is quite well, but has had two or three spells of headache referred to the top of her head which, however, passed off again after some hours.

Case 6—Brain Abscess Seven Months After Radical Operation. Death—

In May, 1903, Miss May L., age 26, was referred by Dr. C. J. Reynolds. She gave the following history: At the age of 2 years she had inflammation of the right ear. At 8 years both ears suppurated; she then remained well until 12 years old, when suppuration for two months in right ear occurred, also later in left ear; right ear continued suppurating intermittently for a long while, and was treated more or less during that time. When I first saw her she complained a great deal of deep seated pain, radiating over the side of the head. Drum head and ossicles were gone. Patient was fairly well nourished, weighing perhaps 140 pounds, and five feet six inches in height. Family history good; she was the only daughter but had two brothers; father and mother both living. The necessity of operation was explained to the mother and daughter and also the probability of deep seated trouble.

Operation—Patient was sent to Deaconess Hospital and on May 20th, with the assistance of Dr. Reynolds, the radical operation was performed. The second blow of the mallet penetrated the sinus; hemorrhage, however, was readily stopped. After removing the posterior wall of the external canal and the external wall of the attic a sinus was looked for because of the severe pain complained of; this was found paralysis lasting three months, otherwise she made a good recovery and was finally discharged.

After History—Seven months later patient presented herself again, having gained twelve pounds in weight. She was feeling quite well except that there was something bulging in her ear. I found, half and inch from the external orifice, a sac coming down and nearly closing the meatus; this was pressed back but gradually filled again, and upon puncturing, pus escaped. She was again sent to the Deaconess Hospital and the skull opened above the meatus. A large abscess in the temporal lobe was evacuated, its walls curetted, the cavity washed out and lightly packed. Patient made a good recovery, but two months later the cavity filled again. Patient had an epileptic seizure which I think had occurred once before. On February 11, '04, the sac was again evacuated, washed out and packed. . She reacted nicely, but after severe pain suddenly became comatose, early the next morning, and died twelve hours later without regaining consciousness. Temperature varied but was never much above 102.

Post-Mortem Examination—This was made sixteen hours after death by Dr. Monroe, the interne who assisted in the last operation. Brain examined only. There was no attempt at healing after first operation nine months previous. Dura mater adherent where epidural abscess was located and was quite normal in appearance. The brain looked healthy excepting the abscess cavity, which was large enough to admit a finger and over an inch in depth. The immediate cause of coma and death could not be ascertained, but was perhaps due to edema of the ventricles.

Case 7—Sinus Thrombosis—

Girl age 11 years, referred by Dr. McCarty of Geneva, N. Y.; middle ear suppuration since infancy, and while under his care thought it necessary to operate radically to prevent intracranial involvement. I was asked to see the child and decided to act immediately. A typical radical was done and the little girl reacted nicely. Next day temperature and pulse were quite normal, likewise the second day, but the third she showed symptoms of a peculiar character, such as fluctuating temperature, irritability and more or less apathy, while at times she lay very still but would respond when called; occasionally she would move restlessly about the bed.

After consultation with Drs. McCarty and Skinner, both surgeons, of Geneva, it was decided to open the skull at once, which was done; while opening up the old wound a little pinhole leading to the lateral sinus was noticed by the bubbling of gas; this hole was then followed up and enlarged by laying bare the sinus, which was covered with organized lymph. The sinus having been opened, a fatty thrombus was found filling up the vessel from the torcular to the bulb of the jugular vein and was removed with difficulty. The child never came to. Odor of a putrid nature emitted from the recently operated bone, but this looked quite healthy, the odor coming from within the skull. This was a peculiarly sad case, especially for the father, he having buried two entire families, and this was one of two children of the third wife.

ABSTRACTS FROM CURRENT OTOLOGIC, RHINOLOGIC AND LARYNGOLOGIC LITERATURE.

I.—EAR.

Intracranial Lesions as Sequelae of Chronic Purulent Otitis Media.

M. ALLEN STARR (*Medical Record,* March 10, 1906). The author has analyzed the literature from 1900 to 1906 and has collected 54 temporal, 25 cerebellar and 2 occipital abscesses, in all 81 abscesses of the brain, secondary to otitis, in which an operation had been performed. In 6 of these nothing was found at the operation, but the abscess was discovered at the autopsy. In 42 cases recovery followed the operation. In 39 cases death occurred. Of the cerebellar cases, 16 died.

He thinks that in almost every instance, it is evident that the operation was unduly postponed, in many cases not having been done until five and sometimes eight days after the abscess was suspected. In the majority of cases he thinks the operation had been badly done, the incision being too small or badly located, and drainage being imperfect. Meningitis occurring after the operation was the usual cause in the 39 cases which died, which meningitis might possibly have been avoided if the drainage had been free, the opening in the head large, and the asepsis perfect. In the cerebellar cases, few characteristic cerebellar symptoms were present.

As the abscess is always of uncertain extent, there should be a large field of operation. The head should be entirely shaved twenty-four hours before the operation, cleaned carefully by many scrubbings with soap, alcohol, ether, corrosive sublimate, and a cap of sublimate gauze should be left on all night previous to the operation. The opening should be very large, four by three inches, preferably omega shape, and a flap of scalp and skull laid down, made either with an electric engine or by a small trephine, openings to be afterwards joined by a small saw or gouge. Thus a large field is open and ample room secured before the dura is touched. All hemorrhage from the scalp and from any arteries of the diploe is to be stopped before the dura is opened. The flap is to be protected during the operation by being wrapped in soft sublimate gauze wet repeatedly with hot water at a temperature of 110.

The dura is to be opened with great care. A semilunar incision is the best, following the line of the opening in the skull. When the cortex is exposed, if the abscess is in sight it can be evacuated by an incision and drained, and turning the patient over so that the abscess shall be down will greatly aid in emptying it.

There may be no abscess in sight, since many of the abscesses lie a centimeter or more beneath the surface. They may be felt, the brain being softer at one point, or may be indicated by the greater venous congestion at one point in the pia. If not, it is justifiable to make a deep incision in the brain. This incision should always be made along the summit of a convolution in its long diameter and the incised surfaces should be separated by two broad, flat spatulae, which thus enable one to get access to the deeper part. The finger should never be thrust into the brain. If a deep abscess is found, it is to be emptied by gravitation. The subsequent drain should be decalcined bone or rubber tissue folded. If the pus found is thick, a gauze drain may act as a plug instead of a drain.

If a diffuse encephalitis is found, and not an abscess, it may be left alone or it may be well to cut the congested and degenerated area out, leaving a cavity. The excision should extend to the limit of the degenerated area so that the walls left are normal brain. Hemorrhage from this may be stopped by sterile gauze tampons held for some minutes in the cavity. Iodoform gauze should never be used about the brain. During the entire operation very hot water should be run constantly over the surface of the brain.

In cases of meningitis and no abscess, a drain may be inserted.

When the operation is finished and the insertion of the drain accomplished, the dura may be united except at the posterior inferior angle or corner of the opening, where the drain is to be brought out. At this point the opening in the skull may be enlarged with the rongeur so that no pressure shall be made on the drain. The scalp is then sewed up except about the drain, and the patient made to lie on the side of the abscess to encourage drainage. The dressings should be changed daily and the drain gradually allowed to be pushed out, but never removed. A very large absorbent cotton dressing held by gauze should be applied over the entire head, as it is important to exclude air from the wound.

Richards.

On the Operative Treatment of Infective Sigmoid Sinus Thrombosis.

RICHARDS (*Archives of Otology*, Vol. XXXIV., No. 5). As infective sigmoid sinus thrombosis of otitic origin is with rare exception secondary to mastoid involvement, the exploration of the mastoid and the removal of its septic foci constitute the primary step of the sinus operation.

The work should be done rapidly and thoroughly. A peculiar fatality hangs over those who for the second time are subject to operative interference because of the error of delay when the intra-cranial sinuses are invaded by micro-organisms.

With conditions favorable, the sinus should be exposed as low down and as near the bulb as possible, in the hope that the thrombus has not involved the entire vertical limb. If the sinus wall near the bulb is healthy and the vessel's lumen seems filled with blood, a compression plug should be placed across the vein at this point and the remaining sinus groove removed by a chisel. The bone must be removed until the involved dura is encircled completely by a strip of healthy membrane.

That portion of the sinus into which empties the emissary vein, must be exposed, for this vessel may enter as a factor of error in judging the return flow.

When operating on cases of mastoiditis in which symptoms of septic absorption pointing to sinus thrombosis are present it is conservative practice to open the vessel regardless of its appearance, of its feel, or of its pulsation, or if on exposure of the sinus, its appearance is suspicious, we should open the vessel, regardless of the lack of symptoms.

When sinus thrombosis has passed into that stage, where it manifests itself through symptoms indicative of sepsis, it has then become formidable, and a large portion of these cases die regardless of surgical interference.

Pulsation of the vessel or absence of pulsation is of little value in diagnosis and aspiration is not only untrustworthy but it is dangerous.

The sinus is treated as one would an abscess cavity. Slit the external sinus wall and exsect it throughout the entire extent of thrombotic involvement (not merely to that point where we get a free return flow). We should rely not solely upon the return flow, but also upon an examination of the interior of the vein to determine the limits of thrombosis.

Before opening the sinus a small cylinder of gauze is placed across the bulb end of the sinus, but the vessel is not compressed and a second cylinder of gauze similarly placed on the torcular side of the point which has been selected for opening. On incising the sinus, should free bleeding occur the operator compresses the plug on the torcular side and blocks the return flow from above. If the bleeding is still free the assistant quickly blocks the return flow from below by compressing the lower plug. If bleeding continues, we should remember that the emissary vein may be responsible and consequently this vessel should previously have been exposed.

By getting a return flow from below, before we exert pressure over the bulb end of the sinus, we minimize our chances of producing unnecessary pressure upon a vessel which is thrombosed, and therefore of discharging emboli into the general circulation. By opening the sinus before producing pressure upon the torcular side of the point of incision, we create an avenue of exit for any portion of a clot which by our manipulation may be set loose.

In opening the sinus great care should be taken to avoid cutting through the visceral wall; by so doing the subdural space is opened and infection invited, and in children, through the act of crying, through sudden increase of intra-cranial pressure, cerebral hernia is possible.

If after the vessel has been slit freely open, as far down toward the bulb as the bone removal permits, we get an insufficient flow from below, we should immediately proceed with a jugular resection and make no attempt to curette the thrombus from the bulb before the removal of the vein. In exposing the jugular vein, we should endeavor to ligate it as low down in the neck as is possible. After removal of the jugular, a bent curette should be inserted into the bulb end of the sinus and such portions of the thrombus as can be detached should be removed. During this manipulation, pressure should be made over the upper end of the internal jugular vein of the opposite side, as aspiration of particles from the involved bulb might occur through this avenue. *Campbell.*

The Indications for Operating in Acute Mastoiditis.

PHILIP D. KERRISON (*Medical Record*, October 28, 1905.) The author regards the aditus between the tympanic vault and the antrum as a constricted portion of one and the same cavity and not a narrow passage connecting two bony cavities, and that the antrotympanic cavity is one osseous space which may be properly described as one having a central constriction, and so bent upon itself that while its roof lies throughout in the same horizontal plane, its floor is lower anteriorly and posteriorly than at the center where encroached upon by the lower margin of the aditus. Hence, as acute purulent otitis media is probably always attended by an escape of pus into the antrum, this presence of pus within the antrum is not necessarily an indication of mastoid inflammation. Neither is marked sensitiveness to pressure over the antrum as is proven by its rapid subsidence as a result of free incision of Shrapnell's membrane and other rational measures for the relief of an acute purulent otitis media. The author does not regard sagging of the posterior canal wall as one of the cardinal signs of mastoid inflammation, as has been so often said, but thinks in the majority of cases that this bulging of the postero-superior canal wall is due to an extension of inflammation from the vault, and bases this belief on the following anatomical, surgical and clinical facts:

1. A section of the temporal bone, more or less horizontal in direction, and passing through the postero-superior canal wall, shows this to consist of a dense, and often thick plate of bone which should act as a natural barrier to the rapid extension of an inflammatory process from the mastoid cells to the membranous lining of the bony canal.

2. While complete removal of all diseased bone is the first aim of mastoid surgery, this indication never in acute mastoiditis requires the removal of any portion of the bony plate which separates the mastoid cells from the membranous canal.

3. In cases of chronic suppurative otitis media in which extensive destruction of the membrana tympani has occurred, characteristic bulging of the posterior canal wall is never present; yet in such cases the posterior wall of the bony canal, as well as the mastoid cells, is often diseased.

He sums up the indications for operating in acute mastoiditis as follows:

1. Sudden cessation of the aural discharge, other symptoms persisting, accompanied by deep-seated pain in the mastoid region and marked sensitiveness to pressure upon the mastoid over an area extending well beyond the limits of the antrum.

2. In the absence of fever, the above symptoms, unless yielding promptly, in 24 to 48 hours, to abortive measures, would constitute a sufficient reason for operating upon the mastoid.

3. Marked tenderness over the antrum, four or five days after free incision of Shrapnell's membrane.

4. Marked variations in the quantity of pus discharged; its maximum flow being, apparently, too great to be explained by the tympanic lesion; its periods of diminution being coincident with the development of mastoid pain or tenderness (or both).

5. Mastoid tenderness having been present and having disappeared, a discharge from the tympanic vault, which resists all rational non-operative measures, may, by reason of its persistence, justify the hypothesis of a necrotic area in the aditus or antrum.

6. Evidences of mastoid involvement having been present, the development at any time during convalescence of symptoms of septic absorption.

He details two cases illustrating conservative treatment.

Richards.

A Case of Cerebral Abscess of Otitic Origin—Operation—Apparent Recovery—Relapse—Operation—Death—Autopsy.

HILL HASTINGS (*California State Journal of Medicine,* October, 1905). Mastoid operation for acute middle ear inflammation done October 6, 1904, microscopic examination of pus showing streptococci. On the twenty-first day, patient was doing housework and the mastoid wound was entirely healed. She remained normal up to December 7th, when there was complaint of severe headache, followed by vomiting and semistupor. December 16th, mastoid wound reopened. Dura uncovered; apparently normal. Aspirating needle pushed directly upward and a little forward to the extent of about ¾ inch into the lobe above the antrum, and greenish-yellow odorless pus found. Opening enlarged with a knife. Pus evacuated. Sterilized gauze wick dressing. Immediate improvement followed. Rubber drainage was substituted for the gauze wick two days later. Drainage was continued until January 3rd.

January 26th, six weeks later, mastoid wound again healed, patient free from pain, doing light household work. Sight good, but a fuzzy optic disk persisted. Two days later there was sudden return of sick headache and vomiting. Mastoid cavity was again opened in the same direction as before. Firm resistance was met at the depth of over one inch, when the needle was felt to enter a cavity, and some thick pus escaped into the syringe. The cavity was opened with a long flat-bladed knife, and as before, fluid pus escaped; altogether a teaspoonful. The external opening was enlarged, the cavity gently irrigated, and the wound loosely packed with iodoform gauze.

As the general symptoms were not improving, another search was made four days later, February 4th, and this time the main abscess cavity was found and opened with the knife at the depth of about two inches. Over 2½ teaspoonfuls of greenish-yellow pus escaped rapidly, evidently from considerable pressure. A large external opening was then made, sufficient to insert the little finger. There was temporary improvement following this operation; several small pockets of pus being found at the time of the dressings and opened. But the general condition again became worse; stupor, gradually increasing to coma, developed, and death resulted three and one-half weeks later.

At the autopsy opposite the openings already described there was found on the right side of the superior longitudinal fissure, on the upper surface of the frontal lobe, a large subdural collection of coffee-colored fluid, about 1½ ounces in amount. This abscess or cyst was circumscribed, and corresponded to the surface of the superior frontal convolution. The underlying brain tissue was not softened or apparently diseased. Two small abscesses, the size of a pea, were found in the anterior portion of the temporo-sphenoidal lobe, in front of and below the main abscess cavity, with which there was no fistulous connection. The main abscess cavity was free of fluid pus. Death probably resulted from the sub-dural collection of pus and extravasated blood on the upper surface of the brain, the infection being carried through the lymphatics along the course of the sulci. *Richards.*

Electrolysis in the Treatment of Chronic Eustachian Stenosis.

Hopkins (*Archives of Otology*, Vol. XXXIV., No. 6.) Setting aside those obstructions to inflation which are due simply to the accumulation of more or less viscid fluid in the tube or about its pharyngeal opening, we find, in general, that inability to inflate the middle ear is due to stenosis of the Eustachian tube—a stenosis which may be either hypertrophic, that is, edematous in character, or hyperplastic. Simple inflation will generally relieve the former, dilatation is demanded in the latter.

Objections to the use of electrolysis for dilatation is largely due to faulty method. One cause of failure is the disregard of the diseased condition of the naso-pharynx. It is necessary to remove adenoids, nasal spurs, polypi or enlarged turbinates in order that the chronic catarrhal condition of the naso-pharynx shall be reduced to a minimum.

One must sterilize instruments, cleanse the nose and naso-pharynx and as a preliminary inflate the tube to relieve it of the mucus and pus which may be lodged therein.

The bougie should be attached to the negative pole and the current tested before being applied. The current must be turned off before the bougie is introduced into the catheter, and after its use must be turned off again before the bougie is withdrawn from the catheter. (The current, however, must be continued while the bougie is in the Eustachian canal.)

After the bougie has been used, inflation must not be employed at that sitting on account of its liability to cause subcutaneous emphysema. If by ill-chance the bougie has made a false passage and blood is found on the bougie upon its withdrawal, it is well to make an application of 8 per cent nitrate of silver solution to the mouth of the tube as a precaution against septic infection.

The passage of the bougie through the Eustachian canal should be made slowly and carefully with not more than 1 milleampere of current until the point of obstruction is reached; then the current may be increased to 2 or 3 milleamperes—rarely to 5—and the bougie advanced with firm and steady pressure until the stricture is passed, while the middle or the ring finger is held against the catheter to prevent any sudden advance of the bougie in case the stricture gives way unexpectedly soon. Then with the same slow motion pass the bougie on until it begins to enter the middle ear.

Begin dilatation with the smallest bougie, No. 1 (French), i e., 1-3 of a millimeter in circumference, use it at intervals of two to four weeks until it is very easily passed and according to the effect produced on tinnitus and deafness and the ease with which inflation is obtained.

After three months or more the next larger bougie is used, going up to 2, 3 and even 4 (French).

The nasal spray is employed daily, and two or three times a week the tube is inflated with a medicated vapor.

In the case of the harder, firmer stenoses, there is a greater inclination to subsequent contraction and it will be necessary to repeat electrolysis every six to eight months.

Campbell.

A Case of Infective Lateral, Sigmoid, Superior Petrosal Sinus and Jugular Thrombosis—Operation—Recovery.

JOHN D. RICHARDS (*American Journal of the Medical Sciences,* February, 1905). This case is one in which the infective thrombosis was of otitic origin, in which the clot extended from the torcular Herophili to the junction of the internal jugular and facial veins, and in which there was prior to the operation neither chill, remitting temperature, nor sweat. A beginning papillitis in the opposite eye was the chief sign pointing to intracranial involvement.

Two operations were done. At the first it was necessary to remove the overlying sinus groove from a point slightly beyond the knee on the torcular side to a point near the jugular bulb; also the bone anterior to the total anterior border of the descending sinus limb for half an inch. Posteriorly it was necessary to make a second perpendicular incision to the original curvilinear incision, peel back a hand-shaped flap, and remove a considerable portion of the occipital bone, thereby exposing the anterolateral aspect of the cerebellar dura.

The case not doing well, the jugular was next ligated at the sternoclavicular joint, and resected. The sigmoid sinus was next curetted. When reaching the region of the sinus knee it was seen that the superior petrosal sinus was occluded. A return flow from this source was not obtained. Incision was next made out to the torcular, the scalp retracted and a canal in the skull corresponding to the external wall of the lateral sinus made. It was found entirely filled with thrombus. Not considering it safe to pass any instrument into the torcular for fear of dislodging the distal end of the thrombus and having it returned as septic emboli through the opposite side into the general circulation, it occurred to the author to block the opposite jugular for the purpose of creating a reverse pressure upon the torcular end of the thrombus, with the hope of dislodging it. This was done, and immediately there followed a slight spurt of blood, and the extrusion of a thin, small, squeezed-out, liver-colored clot, about one-half inch in length.

As a result of this experience he thinks that when attempting to curette a thrombus from the region of the bulb, pressure should be made not only over the internal jugular of the corresponding side, but over both internal jugulars. The aspiratory influence of inspiration is thus more effectually eliminated and the backward pressure noticably increases. By compressing the opposite vein immediately prior to its fellow, the venous system of that side becomes primarily congested, and consequently emboli would not so readily be forced through the communicating veins to the opposite circulation.

Richards.

Double Mastoiditis Complicated by an Intercommunicating Suboccipital Abscess.

HITZ (*Archives of Otology*, Vol. XXXIV., No. 6). A man aged 57 had a copious, fetid, purulent discharge from the left ear. There was sagging of the posterior-superior wall of the auditory canal and a large perforation of the Mt. above the short process. The mastoid over the antrum was extremely sensitive to pressure. A noticeable peculiarity was rigidity of the neck, and pain complained of, upon forcible rotation of the head. Temperature, 100° F.; pulse, 98.

A radical mastoid operation was performed and recovery was apparently rapid, but stiffness of the neck persisted. About two weeks later, after a night of dull earache in the right ear, a paracentesis was done with negative results. Four days later slight edema was observed over the right mastoid and pressure over the antrum caused increased pain in the neck. This mastoid was opened, found to be extensively necrotic with a large sequestrum involving the inner table over the lateral sinus. For the next month the mastoid wounds were clean and granulating nicely, yet the stiffness in the neck made it impossible to turn the head. While examining the neck by deep pressure over the site of the occipital artery on the right side, pus was forced into the right mastoid wound cavity and further investigation showed that the pus came through a small opening in the innermost part of the antral floor. A probe was passed fully an inch in a downward and forward direction, and its removal was followed by a copious flow of thick, creamy pus. The right mastoid wound was reopened, the incision carried backward as far as the lambdoidal suture and the base of the occipital bone carefully exposed. A blunt probe revealed a pocket of pus beneath the occipital attachment of the deep muscles of the neck. While this pocket was being explored, pus began to flow from the external meatus of the left ear, at first clear pus, then bloody and later watery during the flushing of the wound on the right side.

A collection of pus later formed in the left occipital region, corresponding to the region on the right which had been previously drained, and after being widely opened and packed the wounds slowly healed by granulation.

The case is undoubtedly of the class known as Bezold's mastoiditis, but differs from the usual form in that it traveled laterally along the under side of the occipital bone, beneath the periosteum, parallel with the muscular insertion, and did not appear on the surface behind the mastoid apophysis.

Campbell.

A Study of the Disturbance of Function in Acute Perforative Otitis Media.

OSTMAN (*Archives of Otology,* Vol. XXXIV., No. 4).

Range of hearing.—In a series of 10 cases, in all but one instance, the high limit of perception was reduced, in two being as low as d^5, and an elevation of the low limit was noted in every one of the cases. The normal limits, both for low and high tones, were again reached after the inflammatory symptoms subsided. The elevation of the low limit is explained by a diseased condition of the sound-conducting apparatus and a consequent poor conduction of low notes. The lowering of the high limit is believed to have its cause in disease of the labyrinth.

Clinically we may conclude that the greater the extent of the reduction of the upper tone limit, and the longer the reduction, the less the probability of a rapid recovery from the disturbance of function and the less the probability of the disappearance of the subjective noises.

Time perception.—Tests made according to the routine suggested by Hartmann to determine the disturbance in the time perception for the octaves C—c^4 showed that the lower octaves were most affected. For the high octaves, the time perception was shortened in nearly every case, but it was rapidly regained in all but two cases.

It was also observed, that the diminished time perception for the higher octaves stood in direct relation with the subject noises. This would justify the conclusion that the two symptoms are associated, and that they have a common cause, probably circumscribed pathological changes in the cochlea.

Hearing distance for speech.—This method is unreliable, nevertheless a certain relation was found to exist between the decrease in the hearing distance and the lowered upper range of perception for the Galton whistle, as well as a lessened time perception for the higher tuning forks (c^3 and c^4) which would suggest a common cause of these disturbances, viz., a diseased labyrinth.

Weber's test.—In all cases the tone of the tuning-fork on the vertex was most distinctly perceived in the affected ear. Normal conditions were regained in less than half of the cases.

Rinné's test.—Throughout the entire course of all of the cases, a lengthened perception through the bone for the C fork was observed, and in two cases it persisted permanently. The time of perception reached its maximum during the last stages of the otitis and not at the height of the disease, when the air perception was shortened in duration. *Campbell.*

Seven Cases of Thrombosis of the Lateral Sinus; Ligation of the Internal Jugular; Recovery in All.

Eugene A. Crockett (*Transactions American Otological Society*, 1905). In all of these cases, for the details of which the reader is referred to the original paper, the internal jugular was tied but not resected, the author regarding the complete removal of the thrombosed portion of the vein unnecessary except, perhaps, in very extreme cases.

After establishing the presence of a thrombus by incision or exploratory puncture, it has been his practice to tie the internal jugular at a point below the thrombus, or through a firm red thrombus and below the point of softening. Two ligatures are then placed about the vein and the portion between cut out for microscopical examination. The ligatures of the upper portion of the vein are brought out through the neck wound and form a natural drainage tube; the neck is otherwise sewed up. The lateral sinus is then opened and curetted out and a gauze wick drain placed in it.

He has had eleven consecutive cases which have recovered, making a much better showing for the operation than in the simple removal of thrombus from the lateral sinus without ligation. In simple cases ligation of the internal jugular may be done in ten minutes without any shock to the patient. If, however, there is extensive cellulitis in the neck and infected swollen glands outside and inside the sheath of the vessels, it may take from forty-five to sixty minutes and be an operation of great difficulty.

The ligation should always be done early, that is, before the patient has had more than three or four days of high temperature and chills, and before metastasis. Done at this time, recovery may be regarded as practically certain.

Among the early symptoms, beyond chills and high temperature, he regards optic neuritis as the most diagnostic, and thinks it occurs much more frequently in thrombosis than in cerebral abscess or meningitis. The cording in the neck and tenderness along the jugular occurred in only two cases and in all was due to the presence of infected glands near the sheath. *Richards.*

Report of a Case of Panotitis Resulting in Meningitis, with Pathologic Findings.

DIXON (*Archives of Otology*, Vol. XXXIV., No. 6). A nurse, aged 47, six weeks previously developed an acute otitis media. This apparently had run its course and she was being treated for the resultant deafness. Four days prior to admission to the New York Eye and Ear Infirmary during an "examination of the left ear with a probe" she was seized with great weakness and dizziness. There was no chill and no vomiting at this time.

On admission there was on the left side an acute otitis media with slight discharge. No mastoid tenderness. Compression of Siegel's otoscope, when in the external canal, caused marked vertigo. During the three following days there was vertigo, nausea and elevated temperature. On the fourth day she had a chill, mastoid tenderness developed and temperature rose to 103.7° F. There was great pain in the back of the neck along the spine; meningitis had developed. Death supervened on the sixth day.

On autopsy there was marked purulent lepto-meningitis over the superior surface of both hemispheres. The process was, however, more marked at the base of the brain. On removal of the dura, pus was found on the inner aspect of the superior semicircular canal ridge, and the bone was carious at this point. There was pus in the left sigmoid sinus, mastoid and internal auditory canal, and an oval opening 1.5x1 mm. existed in the tegmen antri.

The stapes was partially dislocated and pus passed freely around its foot-plate from the tympanum to the vestibule. There was considerable pus in the perilymph spaces of both vestibule and semicircular canals. The mucous membrane of the tympanum was enormously thickened and the cavity filled with pus. On section of the cochlea, the scala tympani was filled with pus, less was found in the scala vestibuli and there was little or none in the scala media.

The infective germ was Friedlander's pneumococcus. The tract of infection to the meninges appears to have been through the oval window to the vestibule, thence to the vestibule nerves and along the sheath of the seventh pair. *Campbell.*

Report of Two Cases of Mastoidectomy, Sinus Thrombosis, Ligation and Resection of Jugular Vein—Recovery.

McKernon (*Archives of Otology,* Vol. XXXIV., No. 4).

Case 1. A male child, aged 26 months, had an acute otitis one year ago. Two days after a rupture of the left Mt., the right auditory canal was found filled with muco-pus, the Mt. was bulging and a small perforation found in the posterior-inferior quadrant. A smear showed staphylococcus infection. After paracentesis the temperature fell from 102° F. to 99° F. On the fifth day after paracentesis, temperature rose to 103.2° F., and there was beginning right mastoid involvement. On the sixth day the mastoid was opened and a few drops of pus found in the antrum. Ten days thereafter pyemic symptoms developed. Flabby exuberant granulations appeared over the sigmoid groove. The sinus was exposed from above the bulb to one inch posterior to the knee. It was opened and a clot and broken-down material expelled. Free hemorrhage was established at both ends. As conditions were unimproved five days later, the jugular and one inch of the facial vein were resected. The vein contained a clot for 1½ inches below the skull. Recovery from this time on was uninterrupted. (A good rule is to ligate the vein in every case of purulent sinus involvement.—Abstractor.)

Case 2. A woman, aged 30, developed an acute otitis, following a partial turbinectomy, in which most profound septic infection followed. Paracentesis released pus which contained a large number of streptococci and a few pneumococci. Mastoiditis developing, the bone was opened. Pyemic symptoms developed and a diagnosis of sinusitis was made. Six days later the sinus was exposed from bulb to torcular. The overlying bone was dark, almost black in color. The dura was whitish-yellow and lustreless. Disintegrated clot and pus was removed. Thereupon the internal jugular was ligated and resected. Some enlarged glands adjacent the vein were also removed. The subsequent history was uneventful. Healing was rapid.

Campbell.

Some Experiences of the Operative Treatment of the Middle Ear Complications of the Exanthemata.

A. K. Gordon (*Journal of Laryngology,* Oct., 1905). This paper forms one in a series of worthy contributions upon a common subject, read before the Otological Society of the United Kingdom, last June. The writer, the Medical Superintendent of the Monsall Fever Hospital, in England, calls attention to the large number of ear affections in connection with such infectious diseases as scarlet fever. In the city of Manchester, England, as high as 20 per cent of scarlet fever cases had ear complications. From information received from other aurists, he is led to believe that three-fourths of the cases operated upon by them, resulted from an uncured scarlatinal otorrhea. The lack of attention which the ears of the scarlet fever patient ordinarily receives is dwelt upon; even cases of this affection where a cure of all discharge is reported, often suffer from a relapse after a return to their home. To prevent such dangerous sequelae: First, the removal of all adenoid disease is advocated, even in the acute stage, if necessary. Second, the avoidance, if possible, of infection by means of dirty syringes and unsterilized hands. Rubber gloves and glass syringes are to be employed as a means of preventing this.

An early enlarging of the perforation of the drum membrane is recommended to secure proper drainage. This, too often, has proved disappointing and as a means of securing better drainage, the writer has during the last six months performed the radical operation in eighteen cases. The results, both as regards cessation of the discharge and the subsequent hearing, have been satisfactory. He is not prepared to recommend such radical procedure as a routine method of treatment, but would urge that patients should not be allowed to leave the hospital with uncured otorrheas. *Harris.*

Partial Turbinectomy Followed by Acute Otitis, Mastoiditis, Sepsis; Paracentesis, Mastoidectomy, Ligation and Excision of Internal Jugular Vein—Recovery.

CHARLES H. KNIGHT and JAMES F. MCKERNON (*Medical News,* November 18, 1905). Four days after the removal of the anterior end of the right middle turbinate, there having been some systemic depression and febrile reaction on the first two days, the patient was seized with sharp pain in the right ear, for which paracentesis was done. The next day there was decided tenderness over the mastoid, which increased so rapidly that mastoidectomy was done forty-eight hours after incision of the tympanum. Streptococcus was present and every mastoid cell involved in the suppurative process, the whole inner table of bone being of much darker color than is usually found, while the bone over the sigmoid groove was almost black.

The case did badly, there being constant elevation of temperature, not very high, however, until the tenth day, when the temperature rose to 103.8 and there was headache and pain in the vertex. On the twelfth day a diagnosis of involvement of the sinus was made, but owing to the patient's condition, the operation was not done until eighteen days from the time of the mastoid operation, the temperature in the meantime ranging from 104 to 97. Operation was now done and the sinus exposed to just above the bulb, almost back to the torcular. A clot was removed from the knee, and in the lower part of the vein was a disintegrated clot. Owing to the presence of this the internal jugular vein was ligated and resected, the lower point of ligation being below the clavicle, the upper at the exit of the vein from the skull. Both the facial and thyroid veins were also thrombosed about an inch from the internal jugular. The walls of the vein and the glands all contained large numbers of streptococci.

Following the opening of the sinus and the ligation of the vein, recovery was uneventful. *Richards.*

The Lines of Treatment in Preventing Acute Middle Ear Suppuration from Becoming Chronic.

W. Milligan (*The Journal of Laryngology,* Oct., 1905). In Milligan's opinion, the explanation for the large number of chronic cases of septic middle ear diseases is for the inadequate and faulty treatment of the acute condition.

Chronicity to his mind is not a question of the duration of the disease, but when proper treatment fails to relieve the acute condition. One form of the faulty treatment for the acute trouble is the use of the ear douche carrying infection into the mastoid cells. The greatest importance is attached to paracentesis of the drum membrane as a means of securing the proper drainage. Milligan is inclined to attach considerable importance to the particular form of the infection, believing that where it is streptococcal, chronic diseases and intracranial diseases are more apt to follow. The removal of all forms of nasal and pharyngeal obstruction is essential to the avoidance of a chronic condition. This he is in the habit of doing as soon as the patient's temperature has fallen to normal and remains so for a period of five days. The persistent recurrence of pus in the middle ear after removal is an indication of a pus reservoir in the antrum. A case of acute suppurative otitis media, which has resisted an incision of the drum membrane and thorough drainage for a period of three weeks, calls for an opening of the mastoid to secure better drainage. In a series of fifty cases where this rule was followed, without other evidence of mastoid disease, the results have been uniformly successful. No importance is attached to the temperature chart; the condition of the pulse is regarded of greater value. *Harris.*

Brain Abscess—Operation—Recovery.

Philip Hammond (*Boston Medical and Surgical Journal,* January 25, 1906). The patient, 41, said to have had a discharge from the right ear for six weeks, one year previous. Severe pain in the right ear last seven days; no discharge; mastoid tenderness three days; no vomiting, dizziness or chills. Right drum bulging, no perforation, slight mastoid tenderness. Drum incised. Patient placed in bed, ear douched, ice coil. Two days later, found on bath-room floor unconscious. Labored breathing, slow full pulse. Recovered consciousness later. Day following vomited several times. Became dizzy. Some pain over

the right side of the head. Pupils equal, contracted to pin points. Foul odor to the discharge from the ear. No changes in the eye. Mastoid operation done day following. Cortex sclerosed to such a depth that all attempt to reach the antrum was abandoned. The mastoid tegmen was removed, permitting the escape of a quantity of very foul pus. Necrotic area discovered extending through the roof of the middle ear, and over this a small perforation was found in the dura. A director passed through this hole allowed a large amount of foul pus and disintegrated brain tissue to escape. The opening enlarged, probe passed 2 to 3 cm. into a large cavity in the temporo-sphenoidal lobe. The dura was then elevated away from the base of the skull and the whole roof of the temporal bone taken out. A wick of iodoform gauze was passed into the cavity in the brain, and the mastoid opening packed with the same material.

The patient did well after the operation. The drainage proved sufficient and there was no hernia. He was up and about the ward two weeks after the operation, and was discharged six weeks later, general condition being excellent and the hearing of the affected ear practically normal.

Richards.

A Case of Acute Meningitis—Operation—Recovery.

E. A. CROCKETT (*Boston Medical and Surgical Journal,* January 25, 1906). There was a history of more or less constant headache for two months, discharging ear since childhood, with nausea, vomiting and vertigo. The patient was brought to the hospital semi-comatose and general appearance gray and septic. There was nausea, vomiting, severe occipital, frontal and right parietal headache. Temperature 102. There was double optic neuritis. The right ear exuded foul smelling, caseous pus and was completely filled by a large polypus projecting beyond the concha. After the polypus was removed a large amount of bare bone was felt in the tympanum, and a bent probe could be passed into the middle cerebral cavity. The skull was then opened with chisel and rongeur, an opening about 2 cm. in diameter. The dura bulged but did not pulsate; was opened with considerable escape of cerebrospinal fluid, distinct yellow lines or pus being seen parallel with the vessels on the surface of the brain. Probe was passed downward, forward and backward to a depth of 3 cm. and nothing found. Gauze drain was then placed inside the dura and pushed down towards the petrous portion of the temporal bone, the other end brought out through the external skin flap, which was then sutured.

Recovery was rapid and uneventful, the patient being discharged from the hospital at the end of three weeks.

The author believes that many cases of acute suppurative leptomeningitis would recover if operated on at once and a drain put into the subdural space. The cerebrospinal exudate along this drain would relieve the increased cerebrospinal pressure which is what kills most of the patients. In this patient the mastoid was not opened at all for the reason that the infection seemed plainly via the roof of the tympanum.

Vertigo.

A very exhaustive study of vertigo is found in the August number of the *Journal of Laryngology, Rhinology and Otology.* Horsley touches upon the localization of lesions giving rise to vertigo. He maintains that the center of orientation is in the temporal lobe, in proof of which his extensive experimental and pathological observations are offered. This region is directly connected with the cerebellum by Türck's bundle. Apart from the various concomitant affections, such as hemianopsia, which assisted in the clinical localization of the site of the vertigo-exciting lesion, titubation is stated to be characteristic of lesions situated in the opposite direction in extra-cerebellar lesions, so that the sense of rotation of the body was in the opposite direction to that in which the external objects seemed to be moving. When the sense of rotation was accompanied by actual displacement of the body, the patient tended to rotate towards the side of the disease in extra-cerebellar disease and away from it in intra-cerebellar disease. This agrees with the observations of Adler and Guye that in unilateral disease of the labyrinth, there is vertigo with a feeling of movement towards the affected side. They also found that when the head was turned towards the affected labyrinth, a revolving vertigo occurred in which objects turned in the same direction, a condition which did not obtain when movement was made towards the sound side, whereas Stewart and Holmes found that vertigo and the sense of rotation in cerebellar disease is less when the patient is rotated towards the affected side than when rotated from it.

Abscess of the Temporal Lobe.

Blau (*Archives of Otology,* Vol. XXXIV., No. 6). A boy aged 18 had a chronic, fetid discharge from the right ear. The lower half of the Mt. was gone. The malleus was carious and had lost its long process. Graulations filled the tympanum; these were removed but promptly recurred. The ossicles were removed, but the condition was unimproved. On a radical operation being done, the antrum was found filled with pus and granulation tissue and its bony walls and the tegmen carious and soft. The dura appeared to be normal, but showed no pulsation. For five days healing took a normal course, then there were complaints of pain and pressure in the right temple and eye. Three days later vomiting set in, he became restless, then comatose. Left sided muscular twitching; pulse, 140-160. Both pupils dilated, but the right the more so. He speedily recovered consciousness and pupillary reaction to light returned, but the pulse was usually slow, 58-66. Temperature, 36.9° to 37.3° C. The exposed dura became more and more hyperemic and finally very much discolored. On freely incising it, 1½ ounces of yellowish-green pus was liberated. The pulse rose to 72 and the headache and lachrymation ceased. On the dressing being changed on the afternoon of the same day, 1 ounce more of pus was evacuated. As the discharge still persisted, one month later the wound was extended backward and the dura further exposed for an area the size of half a dollar. This large opening allowed the softened brain substance gradually to exfoliate and two months later the wound had closed and the patient was apparently in perfect health. *Campbell.*

Abscess of the Brain, with a Report of Five Cases.

Henry Farnum Stoll (*American Journal of the Medical Sciences,* February, 1906). The first case was one following trauma of the head in a boy of 10 years, who died previous to operation, and at the autopsy an abscess the size of an English walnut was discovered in the right half of the cerebrum.

The second case was one of metastasis of the left lung. Autopsy. In the middle convolution of the left frontal lobe was an abscess 5 cm. by 3 cm. in size. The pus was very fetid, but cultures made from it were sterile.

Case three, aged 24 years, acute otitis media. Operation performed; abscess not found. At the autopsy pus was found in the left parietal lobe, just posterior to the Rolandic fissure, and communicated with the left lateral ventricle.

Case four, followed chronic otitis media. Operated upon. Large abscess evacuated in the temporosphenoidal lobe. Death seven hours afterwards.

Case five, followed chronic otitis media after scarlet fever. Operation. By trephining three-fourths of an inch above the external auditory meatus, grooved director passed downwards, forwards and inwards; two to three ounces of pus evacuated. Cavity enlarged, irrigated with saline solution, rubber drainage tube introduced. Recovery.

The mortality from brain abscess still continues very high.

Richards.

Nature and Aim of Objective Measurement of Hearing, and on the Use of the Objective Audiometer.

OSTMANN (*Archives of Otology,* Vol. XXXIV., No. 4). The author's method of testing the vibratory amplitudes of tuning forks is to fasten them into a vise which is imbedded in a stone wall. The microscope with which the vibrations are measured is placed on an iron plate, likewise imbedded in the wall. Dry flour is strewn on the end of one of the prongs and one of the granules nearest the edge is observed, the excursions being measured with the micrometer eye-piece.

In this way he succeeded with unclamped C and G Edelmann forks from the great to the fourth octave in determining the dying-out curve to the cessation of sound for the normal ear, i. e., to the normal threshold value, so that for the entire duration, the amplitudes, so far as they were not measured with the microscope, could be calculated in intervals of seconds. This was accomplished by interpolation of the values lying between the measured altitudes, and by extrapolation of those parts of the curves of the higher forks whose amplitudes, owing to their minuteness of excursion, could not be measured at àll.

Having determined the normal curves of the unclamped C and G forks from the moment of extreme vibration to their dying out for the normal ear, tables could easily be constructed showing the duration of vibrations in intervals of seconds, the time of dying out and the extent of the amplitude.

With these at hand an objective test is easily, rapidly and exactly carried out. *Campbell.*

Traumatic Atresia of the Auditory Canal.

RUDOLPHY (*Archives of Otology,* Vol. XXXIV., No. 6). After referring to twelve cases of traumatic atresia of the ear canal, all that could be found in literature, he reports a case from his own practice, in which a man was kicked on the chin by a mule, which resulted in compound fracture of the inferior maxilla and injury to both ear canals.

Examination soon after receipt of the injury revealed a swelling on the floor of the right meatus 4 mm. from the Mt. from which blood was exuding. Four weeks later considerable scar tissue had formed so that a small slit along the upper and posterior wall was all that was left of the lumen of the canal. The lumen continued to grow smaller and hearing was reduced to almost total deafness. The sound-perceiving apparatus was apparently unaffected, a fracture of the anterior wall of the auditory canal had evidently resulted in this case and the cartilaginous canal was torn from its bony attachment.

This case demonstrates the advisability in such accidents of endeavoring to prevent atresia by immediately replacing displaced fragments of bone and keeping them in position with a firm cotton tampon.

To relieve this condition an incision is made behind the auricle, the cartilaginous canal is severed from its surroundings and any osseous constriction removed by hammer and chisel. *Campbell.*

Secondary Anesthesia—Hemiplegia as a Complication of the Mastoid Operation.

HARLAND (*Archives of Otology,* Vol. XXXIV., No. 5). A schoolboy aged 8 was operated upon for abscess of the left mastoid. After operation it was noticed that there was considerable loss of power in the left arm and leg, together with some paralysis (?) about the mouth and face. Heart, eye-grounds and muscles were normal. Mental condition good. Urinary examination revealed a moderate amount of albumin with hyaline and granular casts. The measurements of the limbs on the left side show them to be smaller than those on the right. All tendon reflexes in the left upper and lower limbs are increased. This then shows a hemiplegia of long duration and such atrophy could not have occurred in the short time elapsed since operation. Ever since an attack of scarlet fever at the age of 5, the boy screws up his mouth and twists it as he talks. The boy was placed under a general anaesthetic at two subsequent times and each time the hemiplegia temporarily increased.

The boy can now run and use his arms for ordinary purposes, but there is still much awkwardness.

Various theories are advanced for the causation of this hemiplegia, but none appear to the abstractor to be satisfactory.

Campbell.

Communications Between the Blood-Vessels in the Membranous Labyrinth and the Endosteum and Those in the Bony Capsule of the Labyrinth.

SHAMBAUGH (*Archives of Otology,* Vol. XXXIV., No. 6). The author found that in making celloidin casts of the labyrinth in which the capsule was still cartilage, it was not necessary to remove the capsule at all, since the whole preparation would clear up perfectly in creosote. It was also found that where ossification was but partially advanced, the whole preparation was sufficiently clear, so as to permit of the study of the blood-vessels as they penetrated the region of beginning ossification. The embryo calf 20 cm. to 30 cm. in length was used.

By working with this method, communications between the blood-vessels in the membranous labyrinth and those in the capsule could be demonstrated at certain definite points, in the several dozen preparations studied. A characteristic of these communicating branches is that they always consist of a single large vessel which enters the capsule alone, and it is often accompanied by a vein which returns the blood from the capsule to the labyrinth. The points at which such communications were found are then given in detail.

Campbell.

Report of a Case of Infective Sigmoid Sinus Thrombosis and Jugular Vein Infection of Otitic Origin, Without Apparent Mastoid Involvement, in an Adult.

J. L. RICHARDS (*New York Medical Journal,* Dec. 16, 1905). The patient was a man of nineteen who had suffered recently from an acute suppurative otitis, which had healed without incision in the drum membrane. Five days later, a complete facial paralysis developed; seen on the fourteenth day, outside of the paralysis, there were no local signs of ear trouble. Temperature and pulse were normal. Paracentis was performed. On the following day a severe chill occurred with elevation of temperature. A mastoid operation was made which revealed only a few granulations. The sigmoid sinus was then exposed. A patch of purulent pachymeningitis was found over the sinus. The vein was opened chiefly upon "symptoms" and a thrombus was found. Four days after the operation, the temperature rose to 104 with a slight chill, and the internal jugular vein was ligated. The walls of the vein were found to contain streptococci. The paralysis gradually disappeared and the further history of the case was uneventful. The chief point of interest upon which the writer lays emphasis, is the apparent healthy condition of the mastoid itself.

Indications for Opening the Mastoid in Acute Suppurative Otitis Media.

THEODORE HEIMAN (*Annales des Mal. de l'oreille,* March, 1905). The general principles of surgery are applicable here as elsewhere. The persistence of inflammatory symptoms in the mastoid for eight or ten days does not necessarily call for operation—spontaneous cure may supervene. Opening the mastoid before the fifteenth day is rarely indicated, and never early. Before trepanation, antiphlogistic treatment should be tried; paracentesis should be done and the perforation should be enlarged several times if necessary. The operation should not become a measure to save life, but rather one of cure. Indications for operation are: Pain in the mastoid, not due to defective drainage, persisting after two or three weeks; abundant creamy pus prolonged for a month; sensitiveness of the tip; fever, especially after two or three weeks; general weakness, mental depression and gastro-intestinal troubles; meningeal irritation after free drainage is established. Wilde's incision is rarely sufficient to cure. In the main Heiman's views are conservative.

Cerebellar Abscess and Sinus Thrombosis.

Voss (*Archives of Otology,* Vol. XXXIV., No. 6). A man aged 31, who had received a blow on the right ear ten years previously, complained suddenly of severe pain on the right side of the head. He vomited several times. There were convulsive movements and weakness of the lower extremity.

From the right ear there was a fetid discharge. Temperature, 37° C.; pulse, 64.

The radical mastoid operation was undertaken and the antrum found filled with cholesteatoma. For four days after the operation his condition apparently improved, then some edema of the right upper eyelid was noticed and two days later pains on the right side of the head returned. Vomiting became more frequent, optic neuritis and swelling of the optic disc were found. The mastoid wound was reopened and the sinus found thrombosed. Incision of the cerebellum liberated one ounce of thick, fetid pus. A counter opening was made posteriorly to the sinus and the cavity tamponed. From this time on recovery was uneventful. *Campbell.*

The Ear Complications of Cerebrospinal Meningitis.

CHRISTOPHER J. COLLES (*Medical Record,* September 9, 1905). The causative factor of those cases of profound and lasting deafness which occasionally follow cerebrospinal meningitis is probably due to an inflammatory condition of the labyrinth. The infection probably spreads along the extra-labyrinthine intracranial spaces to the endolymphatic and perilymphatic spaces of the labyrinth. The composition of the perilymph and endolymph undergoes a change, due to the presence of the specific germ, the blood vessels become dilated, and true tissue-hypertrophy takes place. The tissues become dense, bone thickening takes place, and often the semicircular canals or cochlea are partially, if not completely, obliterated.

Deafness when it occurs is almost invariably bilateral and it is permanent, the outlook for recovery of the hearing power being very grave and treatment unsatisfactory.

Richards.

Some Displeasing Results of the Mastoid Operation.

J. A. STUCKY (*New York Medical Journal,* Feb. 10, 1906). After commenting upon the great advance in mastoid surgery, Stucky refers to certain unpleasant results which may follow this operation. Among these, he emphasizes the necessity in many cases for a secondary operation, the occasional narrowing of the osseo-cartilaginous canal and granulations in the attic causing atresia of the auditory canal. This, in the opinion of Murphy, is due to faulty packing of the cavity. In 128 cases operated on by the writer, 40 per cent showed some external evidences of pus. These cases resulted in ugly scars; in addition to these, certain disagreeable results, such as permanent unhealed sinuses, are referred to.

In conclusion, the writer lays stress upon the importance of a thorough preparation of the patient before operation, especially the removal from the system of any possible causes for intestinal fermentation.

A Plea for Routine Examination of the Middle Ear.

E. Danziger (*New York Medical Journal*, Nov. 18, 1905). There were 6,000 school children examined in Stuttgart, up to the age of seven: 23 per cent were afflicted with ear trouble. This illustrates the frequency with which affections of that organ are found in children. The close relation of the pharynx to the ear is, the author believes, an explanation of such frequency, but also refers to the intimate relation between the middle ear and intestinal disturbances, and believes that under all conditions it is of the utmost importance to examine the ear in cases of persistent disturbances of the intestines. Fifty per cent of all cases of measles suffer from middle ear complications. In 90 per cent of all diseases of the middle ear, we find, the infection is pneumococcus. The writer believes that the ordinary symptoms of otitis media may be lacking, and urges an examination of the ear as the only means of not overlooking such otitis. He advocates early paracentesis and the dry cleansing as a routine procedure.

A Tropical Affection of the Ears.

Mueller (*Archives of Otology,* Vol. XXXIV., No. 6). Twelve or more cases observed by the author seem to be peculiar to tropical regions. Insidiousness of onset and gradual loss of hearing are marked symptoms.

Solitary boggy swellings which later became organized were found on every wall of the external auditory canal except the superior, and varied considerably in size, the largest extending two-thirds across the lumen of the meatus. Subjective noises of various kinds were complained of. The skin over the growths was always more or less hyperemic. In every instance, spontaneous improvement was noticed with removal of the patient from the unfavorable environments.

It seems probable that a hyperemia of the labyrinth might coexist with the hyperemia of the meatus and thus account for the tinnitus. *Campbell.*

Vertigo of Aural Causation.

Clarence J. Blake, Boston, Mass. (*Boston Medical and Surgical Journal,* October 5, 1905). Vertigo of aural causation may be regarded primarily as a pressure symptom, which may be exerted upon the labyrinth by forces operating from without as a result of changes in the middle ear, or may be produced from within as in the case of hemorrhage into the labyrinth, the effect upon the semi-circular canals, or intralabyrinthine pressure thus produced depending as to its intensity and duration on the location and extent of the hemorrhagic invasion. Recurrent vertigo is the result of an excessive intralabyrinthine vessel dilatation, from suspense of vasomotor inhibition, of reflex origin, either alone or coupled with a persistent intralabyrinthine pressure, of either extrinsic or intrinsic origin. *Richards.*

Report of a Case of Double Mastoiditis with Extensive Involvement of the Zygomatic Cells.

Brandegee (*Archives of Otology,* Vol. XXXIV., No. 5). An Italian boy, aged 15, had suffered from a severe attack of influenza for two weeks. Middle ear inflammation set in with rapid involvement of both mastoids. On operation streptococci in almost pure culture were found. There was a mild leucocytosis and a polynuclear percentage of 84.

The zygomatic cells were most extensively involved. The reporter was surprised at the rapidity of infection, but that is characteristic of influenza inflammation.

Five days after operation pneumonia, which involved both lungs, set in. This ran a mild course and resolution was complete in 16 days.

Perfect recovery ensued with unimpaired hearing.

Campbell.

Diagnosis and Treatment of Suppuration of the Labyrinth.

Stanislaus von Stein (*Annales des Mal. de l'oreille,* January, 1905) describes several cases in minute detail and concludes: Total or partial necrosis of the labyrinth is always accompanied by disorders of co-ordination which are especially marked in jumping with closed eyes. By causing the patient thus to walk and jump and by goniometric measurements, an absolute diagnosis may be made in early stages. Paralabyrinthitis, with or without facial palsy, shows no troubles of co-ordination. When these troubles are observed, perilabyrinthitis or endolabyrinthitis must be suspected. When there is necrosis or caries, the diseased bone should be removed, preferably by gradual morcellation, especially in the young and in involvement of the pyramidal apex. In simple suppuration the area should be opened up and dressed daily.

The Position of the Manubrium in the Normal Drum.

BRUNZLOW (*Archives of Otology*, Vol. XXXIV., No. 6). Believing that the zygomatic arch corresponds to the horizontal meridian of the erect skull, this was chosen as the landmark for measurements.

Of 300 drums examined, the angle of the manubrium with the horizontal meridian averaged on the left side 45°, while for the right side it was 51.6°.

While these observations appear to be unimportant for the recognition of pathological conditions, yet it is well to take in account the tendency for the left manubrium to incline toward the horizontal. *Campbell.*

Pyocyaneus Infections of the Ear.

M. LERMOYEZ (*Annales des Mal. de l'oreille,* October, 1905). The bacillus pyocyaneus seems to produce two types of external otitis, that of Zaufal with a discharge of green pus, and that of Helman with formation of a croupous membrane. Both are characterized by atrocious pain. The bacillus also produces acute otitis media with a sero-sanguinolent discharge, and the formation of sub-epidermic, sanguineous bullae.

The author reports some recent observations confirming his previous opinion that the bacillus pyocyaneus has a special affinity for cartilage, and is often responsible for perichrondritis of the auricle and canal.

Route to the Cavernous Sinus.

H. LUC (*Annales des Mal. de l'oreille,* June, 1905) recently saw two cases of thrombo-phlebitis of the cavernous sinus which inspired him to work on the cadaver with a view to finding a feasible surgical operation for the relief of this condition. He has arrived at the following theoretical procedure:

Free opening through the anterior wall of the maxillary sinus; then through its nasal wall; then into the sphenoidal through its anterior wall; then through the lateral wall of the sphenoidal sinus. Krönlein's method of reaching the ophthalmic vein may be added to this.

Anomalies of the Temporal Bone.

Emil Amberg (*The Journal of the American Medical Association,* June 3, 1905). As the result of measurements of seventeen temporal bones, in which the distance of the most protruding part of the lateral sinus from the suprameatal spine varied from 21 mm. to 6 mm., Amberg concludes that the lateral sinus which comes nearer to the suprameatal spine than 10.6 mm. can be regarded as displaced forward.

In one of his specimens, insead of the usual linea temporalis, there was a pronounced crest extending to the height of 4½ mm. and apparently not having been produced by any pathologic changes. *Richards.*

Recurring Facial Palsy and Alternating Facial Palsy of Otic Origin.

M. Lannois (*Annales des Mal. de l'oreille,* July, 1905) reports three cases. In the first case, the paralysis seemed to be caused by an acute catarrhal otitis, of which there were two attacks. Cure by conservative treatment. In the second case, there was paralysis of the right facial three years ago, and of the left facial in April, 1905, the latter accompanied by tinnitus, mastoid tenderness and other ear symptoms, but no discharge of pus. There was a history of lead-poisoning, which perhaps accounts for the right palsy. In the third case, there was a right facial palsy three years ago, and left palsy recently. The latter attack was accompanied by an acute catarrhal otitis.

Ossiculectomy Under Local Anesthesia for Suppurating Otitis Media.

Milton J. Ballin (*New York Medical Journal,* Feb. 17, 1906). A description of the method employed by Neumann for inducing local anesthesia of the middle ear and the technique pursued by him in the operation of ossiculectomy. The writer has followed this method in a number of cases with satisfactory results as regards the question of pain and bleeding. He gives a brief account of the steps leading up to the present operation, as well as the indications for it, as stated by Politzer.

Technique of Operation for and After Treatment of Otogenous Cerebral Abscess.

HERMANN KNAPP (*Annales des Mal. de l'oreille,* January, 1905) first does the usual radical mastoid. He observes that by following up a fistula or other external sign, a cerebral abscess can be easily evacuated, but in order to effect a cure the focus of infection must be sought out and removed. In acute abscess, where the middle ear is not extensively affected, Knapp opens the mastoid, exposes the lateral sinus and examines the vicinity for necrotic bone foci, which are removed with the curette.

Mastoiditis in Infants.

SEYMOUR OPPENHEIMER (*Medical Record,* March 10, 1906). The pathological changes differ but little from those of the adult, but caries is more frequently found, the deeper structures being often damaged before the conditions are recognized, even the seventh nerve being involved, with resultant facial paresis or paralysis, or pus may break through the cortex with the formation of subperiostial abscess.

While in the young child the mastoid cells are very imperfectly developed, the antrum is always present.

Richards.

Surgery of the Labyrinth.

JULIEN BOURGUET (*Annales des Mal. de l'oreille,* September, 1905) begins with a complimentary reference to Lermoyez's paper, read at the International Congress, describing the diagnostic points of suppuration in the labyrinth. Bourguet then takes up the subject of trepanation, and discusses the anatomy. He then details the technics of Jansen, of Hinsberg and of Botey. He finishes with a description of his own technique, introducing a new instrument, a facial nerve protector, which he uses in trepanning the external semi-circular canal.

Infective Arthritis Complicating Otitis Media.

EAGLETON (*Archives of Otology,* Vol. XXXIV., No. 6). Toxic arthritis may develop during the course of an otitis media suppurativa.

The ear is the most frequent source of general pneumococci infection in children. Netler states that about 63 per cent originate from otitis media.

The character of the local lesion in a typical case is almost distinctive, the most striking feature being the nearly complete absence of circumarticular inflammation. *Campbell.*

Some Remarks Upon Otosclerosis, Apropos of an Autopsy Case.

JORGEN MOLLER (*Annales des Mal. de l'oreille,* March, 1905). The autopsy of this case inclines Moller to regard otosclerosis as an independent primary affection of the bone, and not to be classified with catarrhal troubles of the ear. In this case there were foci of osteitis in the neighborhood of the oval window and cochlea. The mucous membrane was nowhere affected, there being no adhesions or other evidence of any catarrhal condition.

Associated Otomycoses.

LOUIS BAR (*Annales des Mal. de l'oreille,* February, 1905). Many diffuse external otitides, of phlyctenular or vesiculopustular character, are either simple, or are complicated with dermatomycosis. The organisms include aspergillus glaucus and niger, oidium albicans, mucor mucedo, tricothecium, tricophyton, etc. The treatment consists in copious lavage with alkaline (4 per cent sodium bicarbonate) and antiseptic (bichloride 1-1000) solutions.

Thrombo-Phlebitis of the Jugular Bulb of Otic Origin—Treatment.

PAUL LAURENS (*Annales des Mal. de l'oreille,* August, 1905) discusses at length the anatomy, pathogenesis, pathologic anatomy, symptomatology, diagnosis and the different operative procedures. He finishes with the history of two cases in Lermoyez's clinic, one being operated by ligation of the jugular, opening of the sinus and lavage; the other operated by the transmastoid route. In the first case death resulted, in the second cure. As the cases were very similar, Laurens regards the transmastoid method as preferable.

Intracranial Section of the Auditory Nerve.

CHAVANNE and TROULLIEUR (*Annales des Mal. de l'oreille,* September, 1905) discuss this operation for the relief of tinnitus. After a study of the anatomy and experiments upon the cadaver, they propose two routes, the preferable one being an entrance into the middle fossa. The authors have collated three cases, those of Lannois, Wallace and Marriage, and Parry. Of the three, only one survived, and she was not relieved, or at least would not admit it.

Congenital Atrophy of the Right Auricle, with Imperforate Canal—Hemiplegia of the Soft Palate on the Same Side and Atrophy of the Fossa of Rosenmüller.

P. CORNET (*Annales des Mal. de l'oreille,* July, 1905) reports this case in an Arab, aged 25. The atrophy of the auricle was extreme, it being represented by a small fold of skin, containing a bit of cartilage. A small depression marked the normal site of the canal. Hearing by bone conduction indicated a normal labyrinth.

A Simple Method of Dressing Mastoid Cases.

GEORGES MAHU (*Annales des Mal. de l'oreille*, July, 1905), inspired by Eeman's method of suturing the posterior lips of the mastoid wound and insufflating boric acid instead of packing, reports upon some cases which he dressed similarly except that he used no insufflation and simply tucked a bit of gauze into the meatus. He finds it applicable only where there is an otitis, but not where there is a cholesteatoma or tuberculosis.

On the Disadvantages of the Dry-Gauze Dressing after the Operation for Septic Thrombosis of the Lateral Sinus.

GIFFORD (*Archives of Otology,* Vol. XXXIV., No. 4). The writer decries the use of dry iodoform gauze and instead of using a moist gauze such as is usually employed, wets his iodoform gauze in corrosive sublimate solution 1:1000 and covers the operative field and dressings with gutta-purcha tissue. *Campbell.*

Contribution to the Pathologic Anatomy of Mastoiditis.

E. LOMBARD (*Annales des Mal. de l'oreille,* March, 1905) shows that meningitis coming on after mastoid operations is sometimes due to aberrant infected cells which were not cleared out. Such cells frequently exist between the antrum and the pyramidal apex, in the neighborhood of the facial canal. They are usually small.

Double Mastoiditis with Cerebral Symptoms in the Course of Puerperal Infection—Cure without Operation.

H. Massier (*Annales des Mal. de l'oreille,* March, 1905). The patient was accouched February 11th, and developed puerperal infection a week after. The ear troubles came on March 28th. Streptococci found in the pus. Paracentesis; ice to mastoids. Apparent cure in one month, but patient becomes dizzy if ears are not kept stopped with cotton.

Suppuration of the Labyrinth.

Ferd. Klug (*Annales des Mal. de l'oreille,* February, 1905) reports six cases. Scarlatina was the cause in the majority. The state of audition could not be accurately determined, as the patients were mostly children. Paralysis of the facial was found in three cases. In only two cases was disordered equilibration found. Klug favors Jansen's operation.

Hernia of the Tympanic Cavity.

A. de Lins (*Annales des Mal. de l'oreille,* March, 1905) reports two cases, and calls attention to the possibility of mistaking the projecting pouch of mucous membrane for a polyp. They are probably produced by the pressure of pus retained in the accessory cavities, thus pushing a sac of mucous membrane into the tympanic cavity.

Diagnosis of Syphilis by the Otologists.

Rozier (*Annales des Mal. de l'oreille,* March, 1905) reports two cases of secondary syphilis, in which there was marked diminution of bone conduction, and he was thus led to a diagnosis.

II.—NOSE.

Description of Killian's Frontal Sinus Operation.

E. E. Foster (*Boston Medical and Surgical Journal,* January 25, 1906). During the anesthetization, the nasal cavity of the affected side is filled with four tampons made of cotton, rolled into the shape of a small cigar, with a thread fastened about the middle. The first is firmly placed along the floor of the nose; the second in the middle meatus; the third in the olfactory cleft, and the last beneath the bridge and between the frontal process of the maxillary bone and the septum.

The eyebrow is not shaved. There are three distinct incisions—first through the skin; second through the subcutaneous tissues to the periosteum, and third through the periosteum. The first begins at the temporal end of the eyebrow and extends inward through its middle to the nasal end, where it passes downward with a graceful curve along the root and side of the nose to and a little below the base of the nasal bone. Four or five short, superficial incisions are made at right angles to the long one, so that the approximation of the edges shall be accurate at the close of the operation. The eye is covered with a gauze pad. The edges of the wound being slightly separated with retractors, two incisions are made through the periosteum. The first begins at the temporal end of the original incision, extends inward 6 to 8 mm. above and parallel to the supraorbital margin, to the upper end of the nasal bones. The second begins one-quarter of an inch internal to the supraorbital notch and extends inward on the orbital margin until it intersects the nasal portion of the skin incision, which it follows to its lower end. The periosteum covering the anterior wall of the frontal sinus is elevated and retracted. If the outlines of the frontal sinus have previously been determined by skiagraphy, the groove forming the upper margin of the supraorbital bridge, can be made; otherwise an opening must be made into the sinus for the purpose of finding out with a probe its size and shape. The root of the nasal bone is the best place to make this opening. It should be made through the bone with the chisel, exposing but not perforating the underlying mucous membrane. The probe can then be passed between the bone and the mucous membrane, outward, upward and inward, giving information as to the approximate size of the anterior wall: The temporal end of the sinus is then marked off and a groove made from this point extending inward nearly to the median line, close to or a little below the edge of the periosteum covering the supraorbital ridge, that is, 5 to 7 mm. above the supraorbital margin, the object being to leave the bridge completely covered with periosteum. The lower part of this groove forms the upper edge of the supraorbital bridge and should be smoothly and evenly made. As soon as the groove is made deep enough to enter the sinus, all of the anterior wall of the sinus lying above can be removed with bone forceps or chisel, care being taken not to break the bridge during the resection. The anterior wall being removed, the mucous membrane and any partial bony septa are carefully and completely erased, and all sharp corners, grooves or depressions obliterated so as to leave a smooth surface where no pus can be retained. The sinus is loosely filled with gauze and the retracted tissues allowed to assume their normal position.

The periosteum is next elevated and retracted from the nasal bone, the frontal process, lachrymal groove and orbital portion of the frontal bone, toward, but not to, the supraorbital notch. The chisel is placed at the lower end of the suture between the nasal bone and the frontal process of the superior maxilla and driven upward with a mallet along this suture, forming a groove, which groove is extended from the upper end of the suture into the frontal bone, toward but not to, a point midway between the supraorbital notch and the attachment of the trochlea, thus forming the lower edge of the supraorbital bridge. The chisel is again placed at the lower end of the suture as above, but this time it is driven at right angles to the suture, that is, through the frontal process toward the lachrymal bone, care being used not to injure the lachrymal sac. This groove prevents the downward breaking of the frontal process during its resection and is best accomplished by starting at the lowest portion of the frontal process to be removed. The bone is thinnest here and can be easily perforated without injuring the underlying mucous membrane, which is to be preserved for use as a flap. With the bone forceps the largest part of the process is now removed. At the upper end a chisel may be needed. The resection is extended a little way above the frontal process, including a small part of the frontal bone, which is a part of the sinus floor. The removal of this bony area gives free access to the floor of the sinus and the nasal cavity. The periosteum is now elevated from the remaining lachrymal bone and groove, from the orbital portion of the ethmoid bone posteriorly to the anterior ethmoidal vessels, and from the orbital portion of the frontal bone lying inward and downward to the trochlea attachment and supraorbital notch, the limits for elevation and resection being the lower part of the lachrymal groove below, the anterior ethmoidal vessels behind, and the trochlea attachment and supraorbital notch above. The orbital tissues are now retracted outward and held in place by an assistant. The remaining sinus floor is then removed with part of the ethmoid plate and lachrymal bone and as many of the ethmoid cells as is found necessary, and even the opening of the sphenoid cell if it is diseased.

The surface of the whole bony field is made perfectly smooth and the operation completed, by making a flap of the uninjured mucous membrane that covered the resected part of the frontal process of the maxillary bone, and any adjoining healthy mucous membrane. This flap is pushed outward against the adjoining orbital tissues.

The wound is cleaned with normal salt solution and dried, and the whole area carefully examined for projections, nooks and corners which could in any way prevent perfect drainage. A narrow strip of iodoform gauze is loosely placed in the region of the ethmoid cells, an end of which hangs out of the nasal orifice. The remaining part of the nasal cavity is filled with cotton tampons. The tampons and gauze are removed on the second day and not renewed. The skin in the field of operation is cleaned, and the wound edges immediately sewed together with aluminum-bronze wire, unless there be a question of intracranial suppuration or the pus is very foul, or there exists decided necrotic process. In these conditions, the secretion is virulent and ought not to be enclosed in the sutured wound. Suturing is then left until the second or third day. About 80 per cent of the cases are immediately sutured. One per cent solution of atropin is instilled into the eye, the eye is then loosely covered with gauze and a good-sized dressing of moist boric acid gauze placed over all. The patient is put in bed on the sound side, made to lie in this position most of the time for a few days, and is forbidden to blow the nose and told to draw into the throat all wound and nose secretion. The dressings are changed daily and on the fourth or fifth day the sutures are removed. A day or so later the eye is left uncovered. The nasal cavity is not flushed out nor is there much intranasal treatment. At the end of the third or fourth week the wound cavity lying above the mucous-covered nasal cavity is painted with a 2½ per cent solution nitrate of silver.

Richards.

Pathogenesis of Maxillary Empyema.

GEORGES MAHU (*Annales des Mal. de l'oreille*, August, 1905) reports upon 100 maxillary sinuses examined postmortem, in which he found eight diseased as follows:

Four maxillary sinusites of nasal origin.

Three maxillary empyemas of dental origin.

One parulis in the sinusal floor.

He suggests that the following is the mechanism in infection from teeth:

1. Caries of extreme degree (i. e., extending into the root).
2. Apical abscess of a root of the tooth (preferably an antero-external one).
3. Perforation of the floor of the sinus. Penetration of the pus into the antrum, lifting but not perforating the mucosa (closed parulis).
4. Perforation of the mucosa (open parulis, or maxillary empyema).

In none of the dental cases were there granulations or fungosities (so-called pyogenic membrane) on the sinus walls, such as exists in true chronic sinusitis, and Mahu endorses Lermoyez's view that maxillary empyema and chronic sinusitis should be kept distinct. He also calls attention to the resistance of the sinus mucosa to infection from pus of dental origin.

Mahu's report contradicts the accepted figures of 80% dental origin and 20% nasal origin, but he hopes to enlarge his statistics within a year.

Operations on the Accessory Nasal Sinuses.

JONATHAN WRIGHT (*New York Medical Journal,* October 7-14, 1905). As a result of his review of current literature, as well as his own experience, Wright is inclined to believe that too little attention in late years has been given to the intranasal approach to the accessory sinuses, and would limit the external method to operations on the frontal sinus. He speaks with particular favor of the method devised by Jansen for entering the various sinuses through the antrum. He takes a distinctively conservative position in regard to the necessity for radical operation, and feels that the vast majority of cases not operated on, sometimes after years of suffering, it is true, have got well themselves. He would divide all cases he regards as radical into two classes:

First, those patients who are fairly comfortable, with but little annoyance in the nose, no fever, and no pain except at intervals. Such cases he believes will be relieved by intranasal procedures (perhaps combined with the radical operation on the antrum of Highmore).

Second, those urgent, painful, suppurating, febrile cases where there can be no question of the demand for immediate operation. [Wright's position is quite in accord with that taken in a recent article by Hajek, who strongly condemns the over-zeal on the part of many surgeons for the radical operations. —Abstractor.]

Chronic Empyema of the Antrum of Highmore.

G. A. Leland (*Laryngoscope,* August, 1905). The writer's later experience has shown him that large numbers of the cases of chronic empyema of the maxillary sinus may be brought to a successful termination, without radical operation, by intranasal measures of treatment, and is convinced that by comparatively simple conservative measures, following out nature's laws and methods, large numbers of the cases of antral empyemata may be cured without radical surgical interference. "For though 'there is a divinity that shapes our ends, rough hew them how we may,' we do not believe that that divinity shaped our upper end to be unnecessarily rough hewn by every ambitious rhinologist, young or old, with a surgical bent, who may have observed in our large municipal or perhaps European clinics a bold, fascinating, almost reckless dexterity applied to the worst cases that can be found among the lowest classes of society, where the finer sensibilities are in abeyance, or where the victims, through fear of, or in gratitude to, their surgeon, do not magnify their post-operative discomforts, disregarding their lesser ills, because relieved of the greater; but this is rarely the case in private practice, and, for this reason, these conclusions have been drawn from the behavior of those in the higher walks of life."

He is opposed to permanent or temporary openings into the mouth. *Richards.*

The Radical Operation for the Cure of Chronic Frontal Sinusitis.

Thomas J. Harris (*Post-Graduate*, August, 1905). The ideal frontal sinus operation should allow thorough inspection of the entire sinus; free entrance to the anterior ethmoid cells with complete exenteration; free drainage from the sinus into the nose; complete removal of all disease wherever found; be reasonably free from danger to life and from the risk of wounding neighboring organs, as the orbit; have an after-treatment relatively short, and be free from danger of recurrence and of serious disfiguration.

These conditions, he thinks, are in the main admirably met by the method recently advanced by Professor Killian, which is in effect a combination and elaboration of various methods, and acts on the principle that concomitant disease of the ethmoid is present as a rule, and so removes the frontal process of the superior maxilla in order to allow an uninterrupted approach to the disease there and its thorough removal. *Richards.*

The Lymphatics of the Nose and Nasal Fossae.

Marc Andre (*Annales des Mal. de l'oreille*, May, 1905) has an extensive and nicely illustrated article. He shows that:

The lymphatics of the nose are tributary to the parotid, genial, sub-maxillary, sub-hyoid and deep cervical glands.

The lymphatics of the nasal fossae empty into the sub-tubal, pharyngeal, retro-lateral, retro-pharyngeal and deep cervical ganglia; from the base of the skull to the middle of the neck.

To be noted are:

The richness of the lymphatic network.

The presence of numerous free anastomoses in the median line joining the right and left sides.

Anastomoses between the cutaneous and mucous systems.

That the lymphatics of the nose and nasal fossae are not at all independent, but communicate freely with those of adjacent organs.

That, from a clinical point of view, the superior lymph collection of the nasal fossae empty into very inaccessible ganglia, and infection of the latter may be almost unnoticed.

Operation Indications in Certain Forms of Frontal Sinusitis.

E. Lombard (*Annales des Mal. de l'oreille*, June, 1905) gives a very long and complete discussion of the subject.

In acute suppurative frontal sinusitis, if virulent and grave, attempts at drainage by the nasal route should be attempted, but more radical operation may be required.

In non-exteriorized chronic suppurative sinusitis, the author recognizes two forms: first, the sinusitis exulcerens et abcedens of Killian, in which radical operation is demanded; second, a milder form (Zuckerkandl's chronic catarrhal), when the question of operation is a mooted one. Lombard inclines to conservative measures.

Sinusites with external fistulae or attended with complications should be operated.

Lombard discusses at length the various operations applicable.

The Various Routes to the Sphenoidal Sinus.

Jules Laboure (*Annales des Mal. de l'oreille,* May, 1905). The sinus may be attacked:

1. Upon its lateral aspect by resection of the zygomatic arch. Long, complicated and dangerous.

2. Upon its inferior, or naso-pharyngeal, aspect. Scheech's operation. But the inferior surface is sometimes very thick. There is risk of going through the basilar.

3. Upon its anterior aspect. Under this head come the exceptional operations of Verneuil and Chalot, Chassaignac, Ollier, Lawrence, Rouge, Bardenhaüer-Goris and Moure.

The orbito-ethmoidal route has been perfected by Kuhnt, Goris, Chipault, Laurens and Guisez.

The maxillary route, proposed by Jansen in 1892. It has been used by Luc and Furet.

The nasal route, which Labouré prefers, is described in detail.

Deflection of the Nasal Septum in Children.

Arthur A. Bliss (*American Medicine,* November 4, 1905). In the case of deflected septum due to injury, the author advocates prompt and careful examination of the child's nose and the giving of a general anesthetic if necessary. If the operator's little finger cannot be introduced into the narrowed nostril, and the septum pushed into place, a dressing forceps wrapped with sterile gauze, can be used to accomplish this result. A piece of rubber drainage tube, large enough to fit firmly into the naris, and cut about 1½ in. to 2 in. in length, is then introduced. He cuts both ends of the tubing obliquely and inserts it into the nostril, so that the projecting point of the anterior end, coming forward over the triangular cartilage, will fit snugly up into the hollow at the extreme end of the nose, thus anchoring the tube in place. *Richards.*

A Submucous Resection Operation for Deviation of the Nasal Septum; With the Description of Several New Instruments.

Lee M. Hurd (*Medical Record*, November 25, 1905). Hurd has introduced two new instruments for the improvement of the technique of the submucous operation; the first consisting of a speculum with a long upper and a short lower blade, thereby rendering the aid of an assistant unnecessary. The long blade is passed between the membranes and the instrument is used with the long blade uppermost at all times. The instrument is not intended for use until the cartilage has been removed, which allows the entrance of the long blade.

For the removal of the bony crest or the anterior nasal spine, he has devised a stout cutting forceps, which can be used without fear of injuring the membrane. *Richards.*

Adenopathy in Affections of the Nasal Fossae and Rhino-Pharynx.

Georges Gelle (*Annales des Mal. de l'oreille*, July, 1906) discusses adenopathy in acute nasal infections, tuberculosis, lupus, syphilis and malignant tumors. In the first three, the sub-maxillary glands are often involved. Syphilis is usually accompanied by a so-called satellite gland enlargement. Kümmel has called attention to the rarity of adenopathy in tumors of the nasal fossa. In tumors of the naso-pharynx the cervical glands are affected.

Case of Congenital Membranous Occlusion of the Choanae.

L. Bellin and R. Leroux (*Annales des Mal. de l'oreille*, August, 1905) describe this case in a male aged 24. The choanal arches posteriorly were well outlined, but about one centimeter in front was a membranous partition, complete on the left and with a small perforation on the right. Cure after several operations by M. Lermoyez and establishment of nasal respiration and olfaction, neither of which had previously existed.

The Conservative Treatment of Chronic Suppuration of the Frontal Sinus.

W. E. Casselberry (*Laryngoscope*, August, 1905). Of sixteen cases treated conservatively, that is, by nasal methods, six were of a mild type and those were cured. Of the remaining ten typically severe cases, only one was cured, two were much improved, three were somewhat improved, and four were unbenefited. *Richards.*

Chloroforming and Rhinology.

J. Toubert (*Annales des Mal. de l'oreille,* September, 1905) has devised an apparatus by which chloroforming can be mixed with more or less air as desired. He uses a bicycle pump and a funnel ending in a rubber tube, which is introduced through the nose and deep into the pharynx. He cites several cases showing good results.

Osteomyelitis of the Superior Maxilla with Ethmoiditis and Empyema of the Sinus.

Lubet-Barbon and F. Furet (*Annales des Mal. de l'oreille,* September, 1905) report this case in a girl, aged 15: The empyema was believed at first to be due to a true sinusitis, but after several operations, areas of necrotic bone were found from which the pus undoubtedly came. The case is not yet cured, but is progressing rather favorably.

Reflections upon the Surgical Cure of Chronic Frontal Sinusitis.

Pierre Sebileau (*Annales des Mal. de l'oreille,* January, 1905) discusses the Ogston-Luc, Kuhnt and Tilly operations, and describes his own variation of them, which is a resection of the anterior sinus wall and free enlargement of the naso-frontal canal. He uses no drain.

Necrosis of the Superior Maxilla from Phosphorus Poisoning—Operation—Cure.

J. N. Roy (*Annales des Mal. de l'oreille,* July, 1905) reports a case in a woman of 36, a matchworker. The alveolar process was necrotic. The sequestra were removed and the patient recovered.

III.—MOUTH AND PHARYNX.

The Results of Treatment of Cancer in and about the Mouth at the Boston City Hospital.

Howard A. Lothrop and David D. Scanneli (*Boston Medical and Surgical Journal,* April 13, 1905). The cases reported upon were taken from the records of the Boston City Hospital during the nine years from 1895 to 1903 and are 60 in number. Of these there are now living 4, and 56 are dead. The number operated on was 43; the number not operated on 17. The average duration of symptoms up to the time of first observation was 7½ months; the average duration of life after first observation, whether operated or not, 9 months; average duration of life from time of first symptoms, 16 months; average duration in those not operated, 6 months; average duration in those operated, 9½ months.

In cancer of the tongue the operated cases lived twice as long as the non-operated cases.

In cancer of the inferior maxilla, operated cases lived four times as long as non-operated.

Effect of complete or partial excision as lengthening life: Tongue, partially excised cases lived over three times as long as those having complete excision.

Inferior maxilla: complete excision cases lived over twice as long as those palliated.

Superior maxilla: complete excision slightly more than doubled the duration of post-operative life.

Tonsil and fauces: radical treatment resulted in a doubled length of life after operation.

Of 30 cases, 5 were made worse, 3 no better than before operation, 20 temporarily benefited, and 2 cured.

As all unoperated cases die sooner or later of the disease, barring intercurrent affections, and as the duration of life of operated cases as compared with those not operated was in favor of the former by an average of about three and one-half months, the authors believe that if early diagnosis of malignant disease about the buccal cavity can be made, that moderately radical excision of the parts offers the greatest hope of a radical cure, commensurate with the comfort of the patient and the immediate risk to life. If there is extensive invasion of the parts, excision, if done at all, should be done solely with the idea of palliation, without too serious interference with physiological function and without too great immediate risk. *Richards.*

Gangrene of the Tonsil.

CHARLES W. RICHARDSON (*American Journal of the Medical Sciences,* October, 1905). This condition is extremely rare, the author having been able to find but three cases in medical literature, abstracts of which are a part of his paper.

His own first case is a man 45 years of age, with, at first, marked signs of quinsy, followed by pus discharge and subsidence of the swelling, and two days thereafter by white spots on the right tonsil. At first it was thought to be diphtheria, but later the tonsil broke down into one continuous mass of grayish, brownish, putty-like slough, which was the condition when seen by the author on the tenth day of the disease. The opposite tonsil was normal. The patient was in extremis and died two hours after. Antitoxin had been given without any result.

The second case was a man 36 years of age, with a history of sore mouth and throat for several days. At first improvement, followed a few days later by a dirty, grayish-looking patch in the left tonsil, looking at first like diphtheria, but a culture was negative. When seen by the author the temperature was 100 1-5. The buccal cavity seemed normal, with the exception of the right tonsil, the whole surface of which was covered with a blackish, scab-like exudate, with an exceedingly offensive odor. This was subjected to a most vigorous curetting without being able to reach healthy tissue. The tisue removed seemed to be necrotic. Diagnosis of dry gangrene of the tonsil made. The day following it was again curetted and smears taken showing the presence of a diplococcus resembling the D. lanceolatus.

Staphylococci were fairly abundant. Tubercle bacilli and spirillae were absent. Ten days later the patient died from exhaustion. *Richards.*

Observations on One Thousand Adenoid Operations.

Frank B. Sprague (*The Providence Medical Journal*, March, 1906). Five hundred and three of these were male and 497 were females, and ranged in age limit from 6 months to 37 years. Thirty per cent were during the first seven years; 50 per cent during the second seven years, and 20 per cent during the third period of seven years. In 905 cases or about 90 per cent, the adenoids were associated with hypertrophy of the faucial tonsil.

Investigation as to etiology did not lead to very satisfactory results. The author regards the condition as an excessive activity of the lymphoid tissue of the pharynx, at first normal, stimulated by constant irritation from particles of dust or secretions with mild infection; the rapidity and development being governed by the atmospheric, climatic and constitutional conditions and of personal hygiene.

There was only one case of true recurrence, and here the amount of the tissue was very slight. He does not regard recurrence as likely to occur if the primary operation is thoroughly done. *Richards.*

Urano-Staphylorrhaphy.

Owen Smith (*Transactions Maine Medical Association,* 1905). The author has modified the Brophy operation for cleft palate by having silver wires drawn out in such a way that one end remained the size of the original wire while the remaining part was reduced to the size desired for the convenience of manipulation. On the larger end of the wire thus drawn he had threads cut (100 to the inch) and a nut fitted. After this wire is in place, all that is necessary to do is to give the nut a few turns from time to time as the parts are moulded into position, taking up, as it were, the slack in the wires. The method of introduction is the same as used by Dr. Brophy in his operation. Up to the age of three or four years he thinks a deformed face can be brought into almost perfect position. *Richards.*

Three Cases of Polypi of the Tonsil.

S. Bonnamour (*Annales des Mal. de l'oreille,* October, 1905). The first case was notable for the large size of the polyp which was attached to the left tonsil. It measured 3 by 1 c. m. The polypi were single in the other two cases and were of considerable size, but not as large as in the first case.

Bucco-Pharyngeal Syphilis—Multiple and Successive Chancres.

Texier and Malherbe (*Annales des Mal. de l'oreille,* October, 1905) report the case of a 17-year-old boy who had a chancre on each tonsil and five days later developed a third chancre on the upper lip.

A Case of Chancre of the Tonsil.

Joannovich (*Annales des Mal. de l'oreille,* March, 1905). The lesion was in the upper pole of the left tonsil, was indurated, was accompanied by lymphatic enlargement, and produced prolonged dysphagia. Patient was a male, 22.

IV.—LARYNX.

Thyrotomy vs. Laryngectomy—Notes on the Frequently Malign Nature of Chronic Hoarseness.

CHEVALIER JACKSON (*Medical News,* December 9, 1905) reports two cases which show the necessity for early diagnosis in cases of chronic hoarseness and the frequently malign nature if it. He urges that the operation of thyrotomy be done as soon as the diagnosis of malignant disease is made, thereby saving not only the life, but the voice, comfort, happiness and usefulness of the patient. Whereas, when the diagnosis is made late, although total or partial laryngectomy will prolong life for a variable period, recurrence is pretty certain and the extension of existence is accompanied by many discomforts.

The early curable stages of laryngeal cancer are characterized by nothing but hoarseness, which may disappear and recur. Whereas the more positive symptoms of cough, odor, pain, odynphagia, glandular involvement, external swelling, emaciation, cachexia, etc., are present only when the curable stage is past.

Dr. Jackson regards the surgery of malignant disease in the larynx as discouraging only when the case is seen late. He thinks that in early thyrotomized cases the prognosis as to cure is better than it is in chronic laryngitis.

In case 1, the patient came for chronic hoarseness, and on examination a small epithelium about the size of a pea was found on the right cord. Immediate thyrotomy was urged, but declined by the patient, who spent three months of time in getting opinions and treatment from irregular practitioners. Operation was then performed, but what had been intrinsic epithelioma had become extrinsic by extension, so that total laryngectomy was required. The whispered voice was obtained, but eight months later there was recurrence with metastasis and death.

In case 2 the patient, 37 years of age, complained only of hoarseness. Examination showed a small epithelioma of the squamous-celled variety, on the under surface of the right cord. A thyrotomy was done, the thyroid cartilage split in the median line, the growth, with a wide area of surrounding healthy tissue, including the entire right vocal cord, was clipped out. The wound healed in ten days, and now, after four years, the voice is practically perfect, not only for speaking, but for simple song of limited range. *Richards.*

Papilloma of the Larynx in Children.

J. PAYSON CLARK (*Boston Medical and Surgical Journal*, October 5, 1905). Of 12,623 children under fourteen years of age seen in the throat department of the Massachusetts General Hospital from 1889 to 1904, there were 12 cases of papilloma of the larynx, showing the affection to be quite rare in the United States.

The writer reports fourteen cases in detail, and as a result of his experience and a study of the literature, he regards thyrotomy for papilloma in children as unjustifiable. Of the fourteen cases reported, nine were boys and five were girls, and the ages varied from three months to eight years of age, the time elapsing between the appearance of the first symptoms and the application for treatment varying from four months to four years and nine months.

Treatment without tracheotomy was attempted in four cases. One died under the operation, one was lost sight of, one was successful and one after several successful operations required tracheotomy for a sudden attack of dyspnea during an operation. Preliminary tracheotomy was done on the ten remaining cases. Of these, four died; three of bronchopneumonia, and one of sudden suffocation after a difficult second tracheotomy.

The two methods employed for seeing the papilloma were the indirect (laryngeal mirror) and the direct (Kirstein's autoscope or Killian's tubes).

As a result of his own experience and reported experience of others, the writer says that in the future he will employ for these cases tracheotomy only and absolute non-interference with the growth, as in the cases where operative interference was resorted to, the growth returned with increased activity. As in the large majority of reported cases all attempts at removal have affected the growth unfavorably, he believes the best procedure to be to follow Mackenzie's rule to open the trachea in every case where complete permanent aphonia is present, as children can wear a tracheotomy tube with comfort and without interference to the health for years.

Richards.

Pathologic Anatomy of a Case of Recurrent Laryngeal Paralysis—New Theory as to the Cause of Muscle Changes, Especially of the Posterior Crico-Arytenoid.

JULES BROCKAERT (*Annales des Mal. de l'oreille,* February, 1905) advances a theory to explain the predominance of atrophic and degenerative changes in the posterior crico-arytenoid in recurrent nerve palsy. From his case he concludes that the same diseases which affect the recurrent laryngeal, in many cases lead to nutritive disorders in the posterior muscle, which is supplied with blood from the inferior thyroid artery and the inferior thyroid plexus. It is due to mechanical compression of the arteries by degenerated lymphatic masses, tuberculous, syphilitic or cancerous glands, and thyroid and aneurismal tumors. The other muscles are supplied by the superior laryngeal artery, which is not liable to compression by these tumors.

The Presence of Bacteria in the Larynx.

OTTOKAR FRANKENBERGER (*Annales des Mal. de l'oreille,* February, 1905) reports upon the examination of swabs and cultures from the ventricle of Morgagni of twelve healthy persons. He found:

Pneumococcus of Friedlander in	3 cases
Staphylococcus	3 cases
Streptococcus	3 cases
Bacillus pyocyaneus	1 case
Sarcina	1 case
Cladothrix alba	1 case
Micrococcus sulphuratus	1 case
Micrococcus rosens	1 case
Saccharomyces	2 cases

Observations on Four Cases of Total Laryngectomy.

PIERRE CAUZARD (*Annales des Mal. de l'oreille,* August, 1905). In the first case there was accidental death on the fifth day by the canula escaping, and by the efforts of the attendant to replace it, who pushed the canula through the posterior tracheal wall. Second case successful. Third case died with progressive necrosis of the tracheal rings. Fourth case successful after complications. Cauzard concludes that laryngectomy in two steps is preferable to that in one. He recommends: (1) Section of the trachea; suture to skin. (2) Extirpation of the larynx; reformation of the pharyngo-esophageal canal.

Santonin in Laryngeal Crisis of Tabes.

Collet (*Annales des Mal. de l'oreille,* September, 1905) relates the case of a woman, aged 51, having violent crises. After failure to relieve with other medicines, santonin, gr. 15, t. i. d., relieved the attacks. Santonin was continued two months, then stopped; crises recurred and were again checked with this drug.

V.—MISCELLANEOUS.

Pica. Report of a Case of Sugar Eater.

Jacob E. Schadle (*St. Paul Medical Journal,* November, 1905). The term "pica" means a morbid desire for unnatural or strange food. The patient in question presented the usual evidences of a healthy individual. The mucous membrane of the buccal and faucial cavities was dry, smooth and markedly red. The tongue was glossy, dry and red, and the post-nares and the larynx showed the same condition, the whole suggesting the characteristic local appearances of diabetes. The larynx was hyperesthetic, but the soft palate and pharynx were anesthetic. Local applications of chloride of zinc to the larynx were followed by relief. A peculiar characteristic of the case is that prior to twelve years ago the patient had an abnormal appetite for acids, and to gratify this desire indulged in the free use of lemons and sour pickles. At that time her weight was 165 pounds, which decreased in the course of a year's time to 105 pounds. Following an illness at this time, a ravenous appetite for sweets developed, which perverted function she indulged by eating large quantities of sugar. This habit gradually grew until nearly all natural food was excluded from the diet to the extent that she practically subsisted and depended on sugar. This practice has been kept up for twelve years without producing any apparent damage to the system, and the weight has gone up from 105 to 163 pounds. The craving has continued and at no time has she become tired of the sugar.

She has a special bowl which she fills on an average from six to eight times a day with granulated sugar. This vessel she empties just as many times each day by eating the sugar with a teaspoon. No matter what her employment may be, the sugar bowl is always at her side, and while she works or is otherwise engaged, she eats. She is consuming on an average about four pounds daily or about three-fourths of a ton per year. During the menstrual epoch the craving for sugar is intensified, and on these occasions for a few days she ordinarily eats from six to eight pounds per day. Examination of the urine during the menstrual period showed albumin, negative; sugar, positive; specific gravity, 1025. Examination after menstruation, specific gravity, 1008; sugar, negative; albumin, negative.

She was taken off from a diet of sugar for two weeks, but her longing for sugar became voracious and practically intolerable, and she said she could not have endured it much longer, as she grew nervous, irritable, and crazed with a desire to satisfy her perverted appetite. The quantity of water drunk is considerable, yet there is no history of polyuria.

A number of other cases of perverted tastes, quoted from literature, are reported. *Richards.*

Asthma.

SAMUEL KOHN (*Medical Record,* August, 26, 1905). The author has been able to find the reports of only three autopsies and in none of these was there anything characteristic. Thus far no change in the nerve centers has been discovered to which the disease can be positively attributed, hence we are driven to the hypothesis that there must be a molecular change in the nervous centers or a periodic disturbance in their vascular supply, and that the asthmatic attack is the culmination of a series of irritations transmitted to the nerve centers, which finally result in the explosion.

While he does not believe that the operative treatment of the nose for the cure of asthma can be of such widespread utility as its supporters originally claimed, he thinks that all asthmatic patients should have the upper air-tract carefully explored and cocainized to note the effect upon the breathing and any abnormal conditions should be removed so far as possible. Asthmogenic areas should be looked .for with a probe, and if found should be treated either by cauterization with chromic or trichloracetic acid, or galvano-cautery, lightly applied. It must be borne in mind that the asthmatic is such not because of some abnormality in his nose, bronchi, or in some other organ, but because, at bottom, there is a derangement of his entire nervous system. All the other functions of the body should be as carefully looked after for possible disorders as should the nose and upper air tract.

From a therapeutic standpoint he has found nothing so valuable as the iodide of potassium, beginning with one grain doses three times a day and increasing to from 25 to 30 grains a day where borne. It has been his experience in many cases of pure asthma or bronchial asthma that by this means the number and the severity of the attacks are markedly diminished, and that finally the patients remain entirely free from attacks. The iodine seems to stimulate the gland secretion and lower the arterial pressure. *Richards.*

Hemorrhage in Nose and Throat Operations.

EMIL MAYER (*Laryngoscope,* September, 1905). In operations on the pharynx and naso-pharynx, suprarenal extract is inadvisable on account of the danger of secondary hemorrhage following the operation. A careful inquiry should always be made as regards bleeders, and such cases should not be operated upon by cutting methods.

In operating for lymphoid hypertrophies and tonsils combined, the posterior nares should be cleared out first, since if the tonsil be removed first the bleeding is so apt to obscure the field of operation that the lymphoid tissue is but partially removed, the operation being too hastily done.

Patients who have been operated upon under anesthesia in the posterior nares and pharynx should not be allowed to walk about immediately thereafter. The author insists that in operations done in public institutions the patients should remain over at least one night.

In all operations on the nose he puts in a packing in every case in order to avoid the possibility of subsequent hemorrhage. Over seventeen years of age he regards it as better surgery to operate on one tonsil and not do the other until after healing from the first has taken place. *Richards.*

Eucain Lactate as an Anesthetic for Operations on the Nose and Throat.

T. J. HARRIS (*American Medicine,* December 30, 1905) has found eucain lactate to be an excellent substitute for cocaine; it can be employed in the strongest solutions without fear of toxic symptoms, and does not seem to lose its anesthetic qualities under the usual periods of office use. It is not, however, as strong in anesthetic power as cocaine, and in the more painful operations must be used in correspondingly stronger solution, a 15% to 20% solution of eucain lactate corresponding to a 10% solution of cocaine.

For the submucous resection operation he uses the following formula: Eucain lactate, 8 gr.; sodium chloride, 21 gr.; boiling water, 14 drams; adrenalin chloride, 18 mm. Twenty to thirty minims of this solution injected at two or three points of the mucous membrane of the nasal septum produces satisfactory anesthesia. *Richards.*

Legitimacy of the Distinction between Lupus and Tuberculosis of the Upper Air Passages.

E. Escat (*Annales des Mal. de l'oreille,* October, 1905) makes the following differential points: Lupus progresses slowly, descends from the nasal fossae, has multiple points of inoculation, is slow to invade bone, is serpiginous (healing and extending), forms scar tissue like syphilis, has no red aureolas about the lesions, secretes scantily, forming crusts, is indolent, dysphagia is the exception (the surfaces are rather anesthetic), cough is rare, the general health long remains good, heredity is exceptional, the lesions heal under treatment like they do on the skin.

Tuberculosis differs obviously in each of these particulars.

Foreign Bodies in the Bronchi.

Thomas A. Claytor (*American Medicine,* March 17, 1906). Fifty cases of foreign bodies of various kinds are here recorded, of which 38 recovered and 12 died. The death rate of 20 per cent, much less than that usually recorded, is probably attributable to the recent introduction of the bronchoscope. Of 33 patients operated upon, 28 recovered and 5 died, while of 17 not operated upon, 10 recovered and 7 died.

Richards.

Sterilizable Lamp for Diaphanoscopy (Transillumination).

E. Lombard (*Annales des Mal. de l'oreille,* July, 1905) has devised a removable and sterilized glass and metal cover for the bulb.

Foreign Bodies in the Bronchi and Bronchoscopy.

E. J. MOURE (*Revue hebdomadaire de Lary.* etc.) reports two cases of foreign body in the bronchus removed by bronchoscopy. The first was that of a man 63 years old, who suffered from pulmonary abscess due to two fragments of bone which enter the bronchi. An operation was made with the following steps: Incision of the skin muscles and thyroid body, perfect hemostasis by ligature of the veins and arteries, the opening of the trachea below the first ring, introduction of dilator with two blades permitting access to the tracheal canal; after cocainization the reflexes soon ceased. When the trachea and bronchi no longer reacted under the influence of the cocaine, Moure introduced the tracheascope and saw at a depth of 16.5 cm. a mass surrounded by pus. He removed the mass by means of the Killian forceps. A second piece was also removed. In the second case it was found impossible to do any good. Patient died, and on autopsy a fragment of bone of irregular triangular shape was found in the left bronchus a half centimeter from the tracheal spur.

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OF
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AND
LARYNGOLOGY.

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XVI.

A LECTURE ON SOME UNUSUAL MANIFESTATIONS OF SYPHILIS IN THE UPPER AIR PASSAGES.*

By Sir Felix Semon, K. C. V. O.,

PHYSICIAN EXTRAORDINARY TO HIS MAJESTY THE KING.

Gentlemen—There is no more trite expression than the ever-reiterated designation of syphilis as "protean" in its manifestations, yet it would be hard, I venture to say, to point to any affection in which we have voluntarily bound ourselves to more rigid formalism than in our notions regarding the classification and the treatment of the various stages of that disease. It is an axiom religiously believed in, that we must distinguish between primary, secondary, and tertiary manifestations, separated from one another by certain limitations of time, which are, after all, purely conventional, and when we have decided upon registering an individual case as coming within one of these categories, we again feel it to be our duty to prescribe mercury for the first and second of these stages and iodid of potassium for the third. A convention of this kind could of course not have arisen if experience had not taught us that on the whole it answered practical requirements, and far be it from me to shake well-founded belief in the results of such practical experience. From time to time, however, it is well to be reminded that exceptions occur to almost every rule, and that to insist too rigidly upon convention is not wise. Many years ago, I published under a title[1] similar to the one given to this lecture, some instances of rare manifestations of syphilis in the upper air passages, which did not fit into the generally adopted scheme, and having recently had within a comparatively short time the opportunity of seeing a further number of such unusual cases, I avail myself of this opportunity to bring them before the notice of the profession. As they all have occurred in private practice, I shall, for obvious reasons, not give any particulars which could lead to identification of the patients, and for the same reasons shall not mention the names of the practitioners who were good enough to send me the patients or were otherwise concerned in the management of the cases themselves.

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*From the British Medical Journal, Jan 13, 1906.

1. PRECOCIOUS TERTIARY SYPHILIS OF THROAT AND TONGUE OF MALIGNANT TYPE.

A gentleman was sent to me by his medical adviser with a letter from which I abstract the following statements: A year ago the patient got a hard chancre. It had only just appeared when his doctor saw him. He put him on full doses of mercury at once. None of the ordinary secondary symptoms ever appeared, but the patient got a tremendously swelled throat and tongue, and was badly salivated, ropes of saliva pouring out of his mouth. The soft palate became edematous, the tonsils, on each of which a large ulcer appeared, almost met in the middle, and the patient was very ill generally. The medical attendant considered the phenomena as mercurial. Mercury being left off, the ulceration gradually improved, the salivation diminished, and the patient went away to recoup, but returned with his throat again deeply ulcerated.

In consultation with a specialist the affection was considered to be of the nature of secondary syphilis; a return to mercury was advised and practised, with the result that the ulceration,

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(1) On Some Rare Manifestations of Syphilis in the Larynx and Trachea, Lancet, 1882.

as on the first occasion, grew rapidly worse, and the patient became very ill. Mercury was again abandoned, and the patient was treated with "ordinary throat applications." Temporary improvement occurred, but a month or so afterwards fresh ulceration broke out in the throat. On renewed consultation mercury was again advocated and used, with exactly the same result as previously, namely, that the ulceration immediately became much worse, and that the patient was again very ill. Mercury being discontinued, he very slowly and gradually recovered, and was then sent to a great authority on syphilis who, it was stated, took an intermediate view between syphilis and mercurial ulceration, and considered the former to belong to the phagedenic type. He advised the use of iodid of potassium, which, however, the patient was "unable to take in ordinary doses." All this information was given in a letter, the tone of which was perfectly despairing; the writer, who obviously took the greatest possible interest in his patient, had evidently on each occasion, when, either on his own initiative or following the advice of his consultants, he had tried antispecific remedies, particularly mercury, been so much frightened by the extreme violence of the resulting local symptoms and their bad effect upon the general health of his patient, that he had become firmly convinced that the ulceration was of an exclusively mercurial character, and although he laid the case with the greatest fairness before me, it was quite obvious that his own conviction had become so firmly established that no arguments would easily shake it.

The patient was a pale, unhealthy-looking man, evidently in pain, whose speech was guttural and indistinct, his frequent endeavors at swallowing the saliva, which was constantly produced in large quantities, being accompanied by signs of great distress.

On examination, I found the following condition: There was extensive scarring owing to destructive ulceration of the mucous membrane of the palate and fauces, resulting in adhesions, on the one hand between the soft palate and the posterior wall of the throat, and on the other, of the pillars of the fauces with the sides of the tongue. The uvula was entirely destroyed, and there were two perforations—a larger one above, a smaller one below—in the middle line, the larger one of which represented the only communication between the nasopharyngeal and oral cavities. The tongue showed evidence of old ulceration and was fissured; the epiglottis was partially thickened, more particularly on the right side, and on this part, as well as on the sides of the fauces, there was still some active superficial ulceration. The interior of the larynx was free. There was no disease in the nose, the cervical glands were hardly enlarged at all, and there was no skin eruption.

From the appearance described there was no doubt in my mind that the affection was of a purely syphilitic character, tertiary in nature, although appearing at an unusually early time, and revealing a most unusual idiosyncrasy on the part of the patient against antiseptic remedies, particularly against mercury. I wrote in this sense to the patient's medical adviser, and mentioned in anticipation of the natural objection that the throat affection had occurred at a time much prior to the usual occurrence of tertiary symptoms, that I had in 1882 described in the *Lancet* a case in which gummata developed in the larynx within the first year from the primary infection, and that I had on the same occasion quoted a case of Mauriac's, in which as early as two and a half months after the primary infection an evolution of gummata took place, and a statement of Zeissl's that he had seen a nodular syphilide four months after the primary infection. At the same time I proposed that the patient should be sent to Aix-la-Chapelle with the primary object of eliciting the opinion of one of the authorities of that place as to the differential diagnosis between mercurialism and syphilis, and, in second line, of the patient's being treated there for syphilis in the event of the opinion being in favor of the manifestations being specific. This advice was adopted.

The opinion of the physician at Aix-la-Chapelle, taken quite independently of me, entirely coincided with my own. He considered the case one of precocious malignant tertiary syphilis, two instances of which affecting the nose he had previously observed himself. He at first tried to treat the patient with iodipine preparations, and made four injections of 25 per cent iodipine, each containing ½ oz. of the drug, this remedy being chosen because, in the experience of my friend at Aix, this form of iodin is equally mild and efficacious. The result was no more successful than had been the mercury and iodin treatment at home. On the day after the last injection the patient got a painful swelling of the tongue. The tongue itself, as well as the soft palate, became covered with a dirty yellowish deposit in the area where previously simple erosions had been present. This condition got daily worse, and ultimately the entire affected region of mucous membrane became changed into a mass of rather deep and intensely painful ulcers, the general health at the same time deteriorating rapidly. The ulcers were painted with a 10 per cent solution of nitric acid. Under this treatment they became cleaner, but showed no tendency to heal. From this result of the iodipine treatment, the Aix physician became even more convinced than he had been before that he had to deal with a case of malignant syphilis, as in such cases in his experience the inefficiency of mercury and iodin preparations is quite characteristic. The present case additionally, he stated, belonged to a rare variety which he had previously observed, and which is characterized by a tuberculin-like effect of iodine preparations. In such cases the reaction, which ordinarily is quite insignificant, manifests itself by a furious inflammation. This very reaction, in his opinion, made it even more certain that we had to deal with a case of lues, inasmuch as, although mercury may produce ulcerative lesions, such have never been observed under the administration of iodin preparations, often though they be administered, to non-syphilitic persons.

Acting upon this opinion Zittmann's sarsaparilla decoction was prescribed for the patient with immediate and brilliant results. For twenty-six days he daily took in the morning 7 oz. of the stronger Zittmann's decoction, and in the evening 7 oz. of the weaker decoction. This was followed for ten days by Kobert's* sarsaparilla decoction, and finally he took the two Zittmann preparations for another fortnight. Under this treatment his general health improved from day to day, the ulcers cicatrized in the most desirable manner, and ultimately were replaced by a solid scar. The patient's articulation became much more distinct, he could eat without difficulty and pain, and during the whole time hardly ever suffered from diarrhea.

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*The formula of this preparation is the following: Place 1 kg. of sarsa root in coarse powder in a closed vessel with 4 kg. of distilled water, and set aside for three hours, occasionally stirring; heat and keep boiling for one hour, then press out. Repeat this once more. Evaporate the combined decoctions until there remains 1 litre (quart), mix well with an equal volume of alcohol (90 per cent), wash out the residue with boiling alcohol (90 per cent) ½ litre, strain through flannel and filter, evaporate to ½ litre or less. Establish the quantity of parilli and sarsaponia according to the method of v. Schulz-Christophson, and adjust the strength of the finished product either by evaporating or by adding distilled water, so that it shall contain 2 per cent of the above glucosides.

He was discharged with the advice to take Kobert's decoction for another fortnight, and afterwards to discontinue for a time all treatment. When I saw him on his return I found a most pleasing improvement; a dense cicatrix united the remnants of the soft palate with the lateral wall of the pharynx down to the level of the epiglottis. In its midst there was one sharp-cut perforation, and the uvula, as already stated, had completely perished. There was no active ulceration in the pharynx and the larynx was normal. The patient's general appearance and articulation were infinitely better than before he went to Aix. Since then, so far as I know, he has remained perfectly well.

2. Tertiary Syphilis of Larynx and Trachea followed by Isolated Tertiary Syphilis of the Naso-pharyngeal Cavity.

A married lady was brought to me on account of gradually increasing loss of voice and dyspnea, which had come on, it was stated, during the preceding ten days, after a bronchial catarrh. The patient complained of loss of voice and some slight difficulty in swallowing, but, curiously enough, did not attach any importance to the difficulty in breathing, although this was clearly manifested by distinct stridor even during quiet respiration. Tuberculosis had been suspected on account of the laryngeal appearances to be described presently, but two examinations of the sputum made by the Clinical Research Association had failed to disclose any bacilli. There was no history whatever of syphilis.

On examination of the almost aphonic patient it was seen that the left half of the larynx was fixed, and that the left vocal cord, which was distinctly edematous, was bent outwards in its posterior part. The right vocal cord, which was quite white, moved normally. A long way down into the trachea, it was seen that from the walls of the tube on both sides reddish projections extended into the interior, those on the left side projecting more than those on the right. The calibre of the tube was thereby narrowed to such a narrow split that it was surprising that the patient had not got even greater dyspnea. The larynx made no respiratory excursions. There was tenderness on pressure over the front part of the cricoid cartilage. On examination of the chest the tracheal stridor was found to be conducted all over the chest, and nothing else could be heard. There was no skin eruption.

In spite of the absence of a syphilitic history, I diagnosed gummatous infiltration of the larynx and trachea, and sent the patient at once to a home, where she was put to bed with a Leiter's tube round her neck, whilst iodid of potassium in 10-gr. doses and liquor hydrarg. perchloridi in 1-drachm doses three times a day were prescribed for her. It was explained to her and her husband that tracheotomy might become necessary, unless the disease quickly yielded to the treatment prescribed. Fortunately, already on the next day the stridor had somewhat diminished, the patient having passed a good night. From the second day onwards mercurial inunctions according to Zeissl's plan were instituted. This consists, as I have described in the *Lancet*, 1882, in the following: "Twenty grains of mercury ointment were daily rubbed into various parts. On the first day the ointment was applied to the skin of the neck over the larynx, second day to the inner surfaces of both upper arms, third day to the inner surfaces of both thighs, fourth day to the inner surfaces of both forearms, fifth day to the inner surfaces of both calves, sixth day to the skin over both loins, seventh day to the skin of the back." This series is to be repeated four times in the same order, each series being preceded and followed by a warm bath, and astringent gargles being used as a matter of course during the whole time.

Under this treament both the subjective and objective symptoms described rapidly disappeared, and six days after the first consultation practically no trace of the previous serious illness could be detected in either larynx or trachea. The patient went home, but was urgently admonished to continue the inunction treatment for another month. Whether this advice was strictly followed I am unable to say. At any rate, hardly three months later the patient began to suffer from sudden deafness and suppurative otitis media in both ears., At the same time an obstruction to breathing existed, which was located between the nose and throat, and a large ulcerating swelling, evidently of gummatous nature, was found to cover the vault of the pharynx and the upper part of its posterior wall. These manifestations again quickly yielded to mercury and iodid of potassium. In view, however, of the fact that twice within a short time gummata had formed in such dangerous situations, I strongly advised the patient to go to Aix-la-Chapelle, in order to be radically cured, if possible. The patient followed my advice, was energetically treated with inunctions and at the same time with injections of iodipine, while local applications of nitrate of silver were made in the pharynx and nasopharynx to promote quicker healing. Under this treatment complete recovery ensued. The patient six months afterwards once more went to Aix-la-Chapelle to undergo a short inunction treatment as a prophylactic, and has ever since remained perfectly well.

3. Early Fibroid Infiltration of Pharynx and Larynx in a Case of Obstinate Recurring Secondary Syphilis.

The patient was a gentleman, who had been very liable to tonsillitis and pharyngitis for many years. Some years previously he had a hard chancre in the urethral orifice and hard glands in the groins. Hydrargyrum cum creta was given in 1-gr. doses three times daily for four months, under which treatment the chancre and inguinal glands soon disappeared. Hardly any secondary rash occurred, but about six months after the primary infection his throat began to trouble him, his voice become hoarse, and he had difficulty in swallowing. He was then sent to me, and I found a characteristic mucous patch on his right tonsil, whilst the corresponding region on the left tonsil looked suspicious. In the larynx there was marked diffused general thickening of the epiglottis and of the arytenoid cartilages, and the vocal cords were congested. The aspect of the larynx was such that, without the history of syphilis, one would have thought rather of the pseudo-edematous swelling often ushering in laryngeal tuberculosis than of syphilis, but the fact that a characteristic pharyngeal affection existed at the same time, and that, further, the laryngeal swelling was of a much more dusky color than is usually seen in laryngeal tuberculosis, militated against the tuberculous theory. In addition, on careful examination of the lungs no evidence of tuberculous disease was found, and the absence of constitutional symptoms, except some emaciation which was admitted, seemed to point in the same direction. All the same, the possibility of a combination of syphilis and tuberculosis was not lost sight of. From the very first, however, I inclined rather to the belief that this was a case of syphilis pure and simple, appearing in the larynx in the somewhat unusual form of early general fibroid thickening, than a combination of syphilis and tuberculosis.

The weight and temperature of the patient were registered carefully for a while, and his sputum was repeatedly examined for tubercle bacilli. The results were perfectly negative, and the idea of the presence of a combination between tuberculosis and syphilis could therefore be entirely abandoned.

Whilst the syphilitic phenomena in the pharynx were of such a fleeting character that they varied almost from day to day, the aspect of the larynx remained for a time stationary, in spite of continued treatment by oral administrations of mercury, and the patient ultimately decided to go to Aix-la-Chapelle. There he underwent energetic mercurial inunction treatment, with the result that the general infiltration of the larynx very much decreased, and he returned greatly improved. Shortly afterwards, however, fresh mucous patches appeared in the pharynx, a roseolar eruption broke out on his skin, and so considerable an increase of the infiltration of the larynx was noted that I feel sure that nobody seeing the patient then for the first time would have doubted that the condition represented the infiltration stage of laryngeal tuberculosis. He complained of pain in the shin bones, occipital headache, and a general feeling of malaise. Together with these phenomena, syphilophobia of a marked type developed. He commenced to take note of the smallest objective and subjective symptoms in his case, and became greatly depressed. Renewed physical and bacteriologic examinations not having afforded the least evidence of the existence of tuberculosis, Kobert's sarsaparilla decoction was given, but without effecting any improvement. The patient's syphilophobia had by that time increased to such a degree that it became extremely difficult to manage the case. At last iodid of potassium was tried, which I had so far fought shy of, because in view of the already existing infiltration of the larynx I had feared that possibly it might produce laryngeal edema. Its effects, however, were very pleasing. The infiltration materially decreased, the skin eruption disappeared, the difficulty in swallowing, which previous to the administration of the iodid had returned with increased severity, quite vanished, and the patient's voice, which at that time was very hoarse, became natural again. At the same time his general health very much improved, he became more hopeful, and matters at last took a more favorable turn. Quite recently I have heard that under the continuation of liberal doses of iodids his throat symptoms were kept in abeyance as long as he was under observation, but that until the very end he continued to be very nervous about himself, and was always on the look-out for every little adverse symptom.

4. Tertiary Syphilis of the Larynx Manifested Particularly by Periodical Inflammation, with Production of Ephemeral Papillomatous Excrescences.

A gentleman consulted me on account of persistent hoarseness, from which he had suffered for a long time. He at once stated that thirteen years previously he had had a hard chancre, and had since then frequently suffered from cutaneous eruptions and ulceration of the tongue. On examination nothing wrong could be detected on the skin, on the tongue, in the mouth, or in the pharynx, but there was considerable thickening, inflammation, and ulceration of the epiglottis, the free edge of which showed several deeply-cut ulcers. The mucous membrane over the arytenoid cartilages also was greatly inflamed and thickened. The movements of the left arytenoid were deficient. The vocal cords were changed into two rounded cylindrical bodies, but were not ulcerated.

As there could be no doubt that the patient was suffering from syphilitic disease of the larynx of a serious type, and as he had repeatedly and for a long time taken mercurial preparations by the mouth without obtaining a cure, I advised him to start at once for Aix-la-Chapelle in order to undergo a thorough inunction treatment. He followed my advice, with the result that a very considerable general improvement took place; the vocal cords lost their roller-like appearance, and appeared merely slightly congested when he returned, and the thickening about the left arytenoid cartilage became much diminished, although its movements were not entirely regained. After his return he took for some time hydrargyrum oxydulatum tannicum (5 gr. daily) in the form of pills. Unfortunately, however, the improvement was not of long duration. About fifteen months after his return I saw him again, when he spoke with an extremely thick voice, and there was occasional inspiratory stridor. He had had several apparently rather severe choking fits. On examination the epiglottis was seen to be considerably more thickened than it had been, and the outward movements of both vocal cords, particularly of the left, were very deficient. There was also some fresh ulceration on the epiglottis, and the general thickening of the mucous membrane over the arytenoids had increased. I was afraid that the case would turn into one of those serious instances of general fibroid syphilitic laryngitis in which often ultimately tracheotomy and the constant wearing of a tube become necessary, and strongly advised that he should immediately return to Aix and go again through a thorough inunction treatment. To this he agreed.

The report from Aix was this time not so satisfactory as after his first visit. The patient during his stay contracted acute bronchitis after which the infiltration of the epiglottis increased to nearly double its former size. Although some improvement of this condition took place when the bronchitis subsided, the epiglottis remained much more thickened than it had been previously. The arytenoid cartilages diminished in size under the influence of the mercurial inunctions, but now for the first time nodular excrescences made their appearance upon the vocal cords. Before leaving Aix the patient was advised to take sarsaparilla decoction for some time after his return.

When I saw him after his arrival here, the appearances were even less favorable than I should have anticipated from the Aix report. The epiglottis itself was less swollen than I had ever seen it, and there was no trace of active ulceration. The mucous membrane over the arytenoids, however, was still much thickened, and considerable swelling was seen in the front parts of the ventricular bands, so much so that at first sight it looked as if these parts had actually grown together. There was also a great deal of irregular nodular fibroid thickening of the left vocal cord and in the interarytenoid fold, as well as of the posterior part of the right vocal cord. Curiously enough, there was no dyspnea, but the voice was certainly not so good as it had been the previous winter. On examination of the chest nothing wrong could be detected.

From this time onward the disease changed its character in the most remarkable manner. Whilst previously its manifestations had been mostly of the nature of apparently fibroid, deep-seated infiltration, and to some extent of ulceration, these phenomena for a considerable time receded, and were indeed at times conspicuous by almost complete absence. Their place, however, was unfortunately taken by a periodical sprouting of irregular pale excrescences, occasionally condylomatous, but more frequently papillomatous, in shape, which arose sometimes more slowly, sometimes with almost incredible rapidity, from almost any part of the interior of the larynx, but most frequently from the vocal cords themselves, from the interarytenoid fold, and from the ventricular bands. After having been in existence for variable lengths of time, they then always completely disappeared, sometimes spontaneously, sometimes under the influence of antiseptic treatment, either gradually or quickly, just as they had made their appearance. In fact, the aspect of the larynx varied at different times like the figures of a kaleidoscope, and unless I had had the privilege of following these changes up myself, I should not have considered it possible that such grave alterations, as I repeatedly had the opportunity of observing, could be followed by such an almost complete restitution of normal conditions. I need hardly say that the subjective symptoms corresponded with the objective ones. Whilst during those periods when the larynx was filled almost completely with excrescences the voice was extremely hoarse or even almost aphonic, and the respiration noisy and stridulous, in the free intervals there was hardly any hoarseness and the breathing was quite free. These ups and downs were of course attended with a good deal of anxiety and excitement. Several times tracheotomy seemed to be almost immediately required, and more than once I was greatly tempted to remove part, or the whole, of the obstructing masses by intralaryngeal operations. What induced me to withhold my hand was the ever repeated observation that the growths after all always disappeared either spontaneously, or, more frequently, under the direct influence of constitutional treatment; and what prevented me particularly from having recourse to intralaryngeal instrumentation was the consideration that syphilitic scars, as is well known, have a great tendency to extreme contraction. For this reason I was afraid that wounds produced by intralaryngeal removal of the excrescences might lead to lasting stenosis.

Several years passed with such fluctuations as those described. The patient frequently went to Aix, and was each time very considerably benefited, although unfortunately never lastingly cured. Yet there never seemed to be any tendency towards the establishment of irreparable grave changes in the larynx, and never during the time that he was under my care did syphilitic manifestations occur in any other part of the body. In a report which I sent to my friend at Aix several years after the patient had been under my observation I find the following note: "I am surprised beyond measure at the enormous improvement which has recently taken place in the condition of the larynx. The swelling of the epiglottis and of the arytenoid cartilages, the mobility of the vocal cords, and the shape of the latter are so astonishingly improved, that, with all my previous experience, I have never seen such a change for the better as has taken place in this case; and, indeed, I should have considered such an improvement impossible to occur after so much apparently organic infiltration, if I had not seen it with my own eyes. Quite corresponding with this objective improvement the voice, when I saw him a few weeks ago, was marvellously better."

Unfortunately, again, this improvement was not destined to last long. At Aix fresh excrescences appeared on the vocal cords with such astounding rapidity that tracheotomy at one time was considered unavoidable, and I was requested to hold myself in readiness to perform it. Again, however, a sudden improvement—almost overnight—occurred, and the operation could again be postponed.

At that time the patient sought other aid, and for a time I lost sight of him. Later on I was informed that a few months after his last visit to Aix a fresh aggravation took place, and that at last tracheotomy had to be performed under circumstances of great distress, the stenosis having attained an extreme degree before relief was given. The patient then underwent a long series of intralaryngeal operations, partly of a cutting, partly of a caustic, nature, in the course of which a very large quantity of new growths were stated to have been removed. Throughout all that time he had to wear his cannula on account of the still existing stenosis. Recently he returned to me, when I took the following notes:

Crico-tracheotomy has been performed. The patient is still wearing his tube, although it is corked up. The epiglottis is slightly thickened and a little irregular, but not markedly so. The left cord stands almost motionless near the middle line, and is only very slightly abducted during forced inspiration. There is considerable adhesion between its anterior third and that of the right vocal cord. The latter is clotted together with the right ventricular band into one reddish mass. The right arytenoid cartilage is very little abducted in inspiration. The chink of the glottis is reduced to a very narrow, irregular gap in the posterior part of the organ, through which occasionally the shining silver cannula can be seen. The voice is reduced to an absolutely toneless whisper. No active disease can be seen at present in the larynx, and it is stated that for about a year's time no active manifestations of syphilis have made their appearance. Tracheoscopic examination does not reveal any mischief below the level of the vocal cords.

The patient was very anxious to get rid of his tube. His present medical adviser, however, very properly seemed to hesitate on account of the risk of sudden obstruction of the narrow glottis in the event of an acute catarrh. I strongly supported this cautious attitude in view of both the existing stenosis and the possibility of further attacks of the disease itself, and suggested that under all circumstances before an attempt were made to lastingly remove the tube, the adhesions in the front part of the larynx should be split with a cutting dilator, and for a long time dilating tubes, such as Schroetter's, should be introduced into the larynx with a view of further and sufficiently enlarging the calibre of the glottic aperture. At the same time I stated that I considered it possible that the voice might become a little stronger when the adhesions had been divided, although of course restoration of natural voice could hardly ever be hoped for.

REMARKS.

The four cases just narrated well illustrate, I think, the thesis from which I started, that is, that whilst ordinarily it is easy enough to follow the established canons with regard to the diagnosis and treatment of manifestations of syphilis in the upper air passages, yet cases occur in which it is imperative not to be fettered by rigid formulas, and to judge anomalous instances on their own merits only, and not on the strength of general rules. Apart from enforcing this general lesson, each of the four cases offers some important points for consideration. In the first case it is the occurrence of severe tertiary lesions so shortly after the primary infection, and the uselessness, not merely, but the direct deleteriousness of the recognized antispecifics, which confer a particular interest upon it. As to the precocious occurrence of tertiary symptoms, this is, as already stated, although a rare, yet a by no means unheard-of occurrence. Much more exceptional is the damaging effect exercised upon syphilitic lesions by both mercurial and iodin preparations. So tangibly serious were the effects of mercury in this case, that there is little room for wonder that the distinguished practitioner who sent the patient to me for an opinion became firmly convinced that the phenomena seen by him were actually due to mercurial poisoning, a view to which he even now adheres. My reasons for thinking otherwise are the following:

First, we are all familiar with the effects of mercurial poisoning when appearing in the throat; we know the stomatitis, the profuse ptyalism, the ulceration of the interior of the cheeks, the fungosity of the gums, and the decay of the teeth; but I am not aware that ever a case has been described in which conditions such as those observed in this case—destructive ulceration of the mucous membrane of the palate and fauces, loss of the uvula, perforation of the hard and soft palate, extensive ulceration of the tongue, extensive cicatricial adhesions—have ever been observed as a result of mercurial poisoning.

Secondly, as already stated, it is of great importance that damaging influence was exercised upon the process, not only by mercurial but also by iodin preparations, and here it is particularly noteworthy, as insisted upon by the physician at Aix-la-Chapelle, that actual ulceration followed the administration of iodin, whether administered by the mouth or by subcutaneous injections, a result never produced in ordinary cases of idiosyncrasy against iodin preparations. However violent the symptoms of iodism may be—I have seen several very instructive instances of the kind—active ulceration has never been amongst them.

Thirdly, it is particularly important that twice in this case, before the patient came and saw me, active ulceration had made its reappearance spontaneously a long time after mercury had been discontinued.

Fourthly and lastly, the condition left behind after the period of ulceration is so absolutely characteristic of the ravages of tertiary syphilis, that I feel sure that every experienced observer who were to see the patient now for the first time would, without a second's hesitation, declare that the lesions were due to tertiary syphilis.

I therefore feel perfectly justified in bringing the case under your notice as an instance of malignant, precocious tertiary syphilis, and in recommending to you in similar cases not to persist with the administration of mercury and iodids, but to have recourse to sarsaparilla in the form of Zittmann's and Kobert's decoctions.

The second case—the one in which tertiary syphilis of the larynx, and especially of the trachea, was followed by isolated syphilis of the nasopharyngeal cavity—offers a good illustration of the truth of the, if somewhat cynical, yet excellent, advice: "Whenever you have to do with a particularly obscure case, think of syphilis as a possible cause." Here was a married lady of unimpeachable antecedents and without the least history of syphilis, who at a mature age suddenly developed the serious symptoms described. It is the absence of the syphilitic history to which I would particularly draw your attention, and from which I would again deduce the lesson, which I have been endeavoring to enforce on more than one previous occasion—namely, to trust to the evidence of your own eyes rather than to the absence of a characteristic history. From what has come under my own notice on a good many occasions, I think it is desirable that this necessity should periodically be emphasized. At the same time, I would take the opportunity of urging the need of the utmost caution, when dealing with such cases, to guard against any imprudent expression of opinion as to the nature of the case you have to deal with. In no class of cases are tact and diplomacy more required than when dealing with syphilis in married people, and the attendant should always remember that a single incautious remark of his may forever destroy the happiness of a family. When remembering the incidents of the case now under consideration, the necessity of such a warning is very deeply impressed upon me. Quite apart from these points, the case is also remarkable for the fact that one not very common localization of tertiary syphilis—namely, gummatous infiltration of the trachea--was followed within a very short time by an even rarer one—namely, the formation of a gumma in the nasopharyngeal cavity.

In the third case two points deserve special attention—namely, first, the occurrence of extensive infiltration of the larynx shortly after infection, and at a time when the ordinary phenomena of the second stage, namely, roseola on the skin and mucous patches in the pharynx, were still present; and, secondly, the terrible syphilophobia to which the patient became a victim after repeated recurrences of the disease. With regard to the first point, I would say that in my own opinion this was a case in which secondary and tertiary symptoms intermixed—an occurrence the possibility of which ought always to be kept in mind. Ordinarily, in secondary syphilis of the larynx the phenomena are simply those of erythema; more rarely do we meet with formation of condylomata and with actual superficial ulceration. I have never previously seen so extensive an infiltration of the larynx take place in genuine secondary syphilis, nor am I aware that such has ever been described. Another reason why I am inclined to look upon the laryngeal phenomena observed in this case as belonging to the tertiary period is the failure of mercury to prevent recurrence of the symptoms, whilst the disease, as long as the patient was under observation, was kept under control by iodin preparations. I am sorry I cannot say what ultimately became of the patient, my endeavors to trace him having failed. Whilst one could not help sympathizing greatly with the poor man in his recurring tribulations, the syphilophobia which he developed ultimately became almost as trying to his medical advisers as to himself. In such cases the medical attendant must not merely be an adviser of the body, but also of the soul. Some unfortunate syphilophobes fall into a condition of melancholy, others become quite frenzied, and not merely threaten but are actually apt to commit suicide. Under such circumstances it is the duty and the privilege of the medical adviser to maintain courage, to cheer up, and to always hold out the hope of ultimate and lasting recovery. A despondent attitude on the part of the medical attendant is the surest way to drive the patient into utter despair.

The last case is, without exception, the most unusual instance of syphilis in the upper air passages which I have ever met. I have made it a point to look through literature with a view of discovering whether ever a similar case had been described, but have not found one. Whatever the causes were which repeatedly produced new growths—which almost completely filled the patient's larynx, then made them disappear, leaving the organ but little disfigured, and then again and again produced fresh crops, to be followed by similar disappearance—I am quite unable to say. Nor can I explain, in view of the long interval before the patient's last visit, in precisely what manner the present condition of his larynx has come about.

In conclusion, gentlemen, let me say that the simple narrative I have given illustrates, I think, better than any elaborate commentaries, how little one single form of antisyphilitic treatment can claim to be universally successful in all cases. In the great majority of my own cases of syphilis of the upper air passages, methodical inunction treatment has been most successful, and I trust this more than any other method. Yet you have heard that in two out of these four cases it failed. The therapeutic lesson to be derived from the experiences gained in these four cases, it seems to me, is that as in diagnosis so in the treatment of syphilis, it must be our aim to individualize when the ordinary canons show themselves insufficient to cope with the particular case, and not to insist on preconceived notions of any kind.

XVII.

AN UNUSUAL GROWTH OF THE MASTOID PROCESS, FIBRO-CHONDRO-OSTEOMA OF THE MASTOID ANTRUM.*

BY S. MACCUEN SMITH, M. D.

PHILADELPHIA.

The following case is of interest, in the first place from the fact that a growth was found in the mastoid antrum during an operation for chronic otorrhea, but more especially on account of it being attached to the necrotic surface by one short slender pedicle, and yet the pathologic examination showed it to be composed of fibrous, cartilaginous and osseous structure. When first observed it resembled a fibrous polypoid growth, was movable in all directions within the radius of its pedicular attachment, and did not bleed when detached from its thread-like pedicle.

The history of the patient is as follows: Master M. L., 16 years of age, was born of healthy parents, and never suffered from any diseases peculiar to childhood except measles when four years of age, and his parents are not aware of his having had any ear complication from this illness. His only other illness was a severe attack of typhoid fever two years ago, from which, so far as is known, he made a good recovery without any suggestion of aural involvement. The patient, as well as his parents, deny positively that he ever had any trouble with his ears until about the middle of November, 1905, when it was noticed that the hearing of the left ear was rapidly becoming impaired. His physician was consulted and on examination found some foreign matter in the ear which he diagnosed as "wax," which forceful syringing, however, did not remove. Forceps were then resorted to and the traction produced marked vertigo and some bleeding, at the sight of which the physician became alarmed and sent him to the Jefferson Hospital the following day, where he came under the care of the writer. An examination showed a large fibrous polypoid growth filling the entire canal, the pedicle apparently having its origin in the tympanic cavity.

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*Read before the Eastern Section of the American Laryngological, Rhinological and Otological Society.

He was admitted to the Jefferson Medical College Hospital on December 6th, 1905, and operated on the following day. After removing the growth, we found an extensive hyperostosis of the posterior wall of the external auditory canal, which so far obstructed the lumen of the canal that the tympanic membrane could not be seen. As a very foul odor came from the brownish-yellow discharge that escaped following the removal of the polypus, we concluded to perform a radical mastoid operation as a means of correcting the hyperostosis and the evident necrosis of the tympanic cavity and mastoid antrum.

The entire mastoid process was of the eburnated variety until the antrum was reached, which forced the conclusion that the case was, after all, of the usual chronic nature, notwithstanding the protestations on the part of the patient and his family to the contrary. The antrum and tympanic cavity were extensively involved in the necrotic process, while the malleus and incus had become disintegrated, probably some months or years ago, and made their escape in the discharge.

The tumor was located in the inferior and anterior part of the antrum, and filled in the concavity caused by the more or less drooping of the canal adjacent to the hyperostosis.

Growth, natural size.

The following is the report received from the Jefferson Hospital pathologist, who made the examination of the tumor: "The specimen is an ovoidal mass 1 cm. long, 0.6 cm. wide and 0.3 cm. thick; weight 0.2 gm. The surface is smooth, glossy, slightly nodular and greyish-pink in color. The tissue is hard at some points and soft and elastic at others.

The specimen was fixed in Zenker's solution, decalcified in 10 per cent nitric acid, then dehydrated, infiltrated with paraffin, sectioned and stained with polychrome blue, hematoxylin and Van Giesen, also eosin.

Histology:—The sections are almost completely marginated by stratified squamous epithelium. At some points in this structure the four layers of the epidermis—the strata cornea, lucida, granulosa and Malpighii—can be distinguished, while at others but a few rows of the strata cornea and Malpighii are present. Typic prickle cells are not demonstrable. The stratum papillare of the corium presents numerous elevations and depressions where the epidermis is thick and shows all its layers, but is absent where but a few rows of the corneal and Malpighian strata are in evidence. That part of the margin not covered by skin is formed by a band of fibrous tissue and this is probably the point of attachment of the specimen to the contiguous tissues. Beneath the skin are areas composed of loosely-woven strands of fibrous tissue transmitting numerous small bloodvessels; at points the perivascular structures are densely infiltrated with mononuclear leukocytes. The sections also contain trabeculae of fibro-cartilage and here and there harder and denser areas, osteoid in character, which necessitated decalcification in order to section the specimen. At the sides of this cartilaginous tissue are numerous multinuclear cells varying from 40 mikra to 70 mikra in length and from 10u to 25u in breadth. These cellular elements are indistinguishable from chondroblasts and near them the cartilage is eroded and degenerated; this destroyed tissue is being replaced by a loosely-woven, fibrillated and cellular fibrosa. In the structures between the cartilaginous trabeculae are numerous large lymph sinuses, some of them empty, while others contain a granular acidophilic material.

Diagnosis:—Fibro-chondro-osteoma of the mastoid antrum.

XVIII.

THE INDICATIONS FOR OPERATIVE INTERFERENCE IN MASTOIDITIS ASSOCIATED WITH ACUTE SUPPURATIVE OTITIS MEDIA.

By T. Melville Hardie, M. D.,

CHICAGO.

It is difficult to believe that practically all of the life-saving work in ear diseases has been limited to the past thirty-five years. (Schwartze's work was published in 1873.) Before that time mastoid operations were not performed unless a perforation of the cortex of the bone had taken place with consequent swelling, redness and fluctuation over the mastoid process, and even at the present time it is possible to meet practitioners of medicine who have never observed a case of mastoid inflammation which demanded operation, although they have had patients succumb to one or other of the well-known intracranial or general complications or sequelae of the disease.

It should be possible for everyone to decide in a large proportion of cases whether operation is necessary. In the remaining number he can obtain assistance in every city which possesses an oculist and aurist who can use a head mirror and ear speculum as well as he can his ophthalmoscope.

The formulation of rules for the guidance of the inexperienced is always a difficult undertaking, and in this case the difficulty is increased from the fact that the structure of the parts involved and the virulence of the infection are so variable that the symptoms, subjective and objective, vary likewise, even when the pathologic conditions within the bone are similar, and my single suggestion is that if we err at all it should be on the side of safety. One should operate too early rather than too late. We may now proceed to an enumeration and description of the symptoms which demand operation.

1. *Pain.*—Consider its duration, situation and severity. Pain in the mastoid region is a very common symptom. It is frequently described by the patient as deep, boring, nauseating, usually worse at night. It is often just severe enough to cause

sleeplessness. It may have come on with the acute inflammation in the ear, or it may not develop until some days after the ear has begun to discharge, or it may begin only when the previously profuse discharge from the ear has suddenly stopped.

Pain on pressure is a very important symptom of mastoid disease, but care must be taken both as to the method of eliciting tenderness and the situations chosen for its early demonstration. It must be remembered that very gentle pressure over an acutely inflamed periosteum might cause excruciating pain, while deep pressure would be required to elicit pain when the inflammation was deeply seated in a bone, the structure of which was dense and compact.

Pressure, therefore, with the end of the thumb or forefinger is to be slowly and steadily increased over the antrum, the mastoid tip and the region of the mastoid foramen. When endeavoring to elicit antrum tenderness, the pressure is to be made just behind the auricular attachment and upwards and backwards from the external canal. Care must be taken, if there is any question as to the co-existence of mastoid disease and furuncle of the external meatus, that neither the ear nor the cartilaginous meatus is moved. When examining the tip be sure to compare the two sides, as the normal tip is often sensitive to pressure.

Tenderness on pressure over the emissary vein which comes out through the mastoid foramen is also important, even although its presence does not indicate thrombosis of the sinus.

Finally, it is to be remembered that exceptionally cases of mastoid disease exist in the absence of pain on pressure, and that not merely furuncle but occasional otalgias of hysterical or other origin may attempt to confuse us. Of equal importance, therefore, from a diagnostic standpoint, is the information we obtain by an examination of the external canal and drumhead.

2. The drumhead is markedly bulged forward or outward frequently even after perforation has taken place. The perforation is oftenest situated on the apex of this projection, in the posterior superior quadrant of the drumhead.

3. Of even greater importance and, when it is present, a positive indication for performing the operation, is bulging or sagging of the skin of the posterior superior wall of the meatus, near the drumhead. In this case, again, external otitis (furuncle) is to be excluded.

Symptoms 2 and 3 require upon the part of the examiner ability to use the head mirror and ear speculum. Seeing in this case is not merely believing but knowing, and the writer has always believed that the greatest service one can render his students in otology is to teach them the use of the mirror, so that their inspection of the drumhead may be adequate. It is worthy of mention that this symptom may be absent or not marked in cases in which, while there is free drainage from the middle ear and antrum, an abscess exists at the mastoid tip.

4. *Discharge.*—Very frequently the discharge of pus is profuse, and if this has lasted for a week or more the necessity for operation is probable. In many cases the discharge suddenly diminishes greatly, or stops altogether, while the process in the mastoid progresses. A bacteriologic examination of the pus is advisable, since, when the infection is due to streptococcus or pneumococcus, operation should be performed earlier, and the infection is likely to be more severe. This is particularly true of cases occurring in children.

The old-time symptom of edematous swelling, or swelling and reddening of the skin of the mastoid very often indicates neglect. When this is marked the auricle stands away from the head, and if this occurs after the disease has existed for some weeks, extensive absorption of bone in the process and frequently perforation of the cortex has taken place. If the swelling occurs early the abscess is superficial, or the edema and other inflammatory symptoms are due to the periostitis associated with furuncle of the canal.

6. Another local symptom is a marked increase in temperature of the affected as compared with the sound mastoid.

7. Percussion of the mastoid performed with index finger or small hammer, is to be regarded of diagnostic value if used in connection with other symptoms, especially if the dulness develops while the patient is under observation, but its value as a diagnostic aid is very limited because there is sometimes no difference in the percussion sound of the healthy and the diseased mastoid, and the sound may differ in the two normal mastoids of the same individual. Further, it cannot be used when there is swelling over the process. (Politzer, Diseases of the Ear, p. 504).

8. Andrews' test to determine the density of the mastoid, and hence the presence or absence of disease, is open to the

same objections since it depends upon the same physical laws. Andrews' test (Laryngoscope X., 416) is made by placing a stethoscope with a small bell over the tip and placing the handle of a C_2 tuning fork over the antrum. It is found that when the mastoid cells are filled with pus or granulations, or when the density is increased from bone proliferation, the sound waves are transmitted to the ears of the examiner with greater intensity and for a longer time than occurs when the mastoid is normal. No traction should be made upon the soft tissues since this will increase the sound.

9. I have said nothing, as yet, of the systemic manifestations of the disease because they are not, as a rule, characteristic. Usually temperature, pulse and respiration are not materially affected excepting in children, in whom the temperature may rise to 104° F., even in uncomplicated cases. While there is usually a slight elevation of temperature in adults, and frequently one going to 101° or 102° F., fever may be entirely lacking. (Grunert A. f. O. XXXV.)

Decided prostration, indisposition to exertion, when present, are suggestive. Chills, vertigo, nausea, vomiting, sweating, are unusual excepting in the presence of intracranial complications. These occur more frequently in chronic cases but must always be looked for, since operation must be performed promptly in the event of their onset.

Every case of acute mastoiditis complicating acute suppurative otitis media should, of course, have the benefit of preliminary antiphlogistic, or so-called abortive, treatment before operation upon the mastoid is undertaken. This will include the free incision of the drumhead in the upper posterior quadrant and including the sagging inner portion of the posterior wall. Cold, either by means of the Leiter coil (of aluminum) or thin rubber ice bag should be applied for not longer than forty-eight hours. Too prolonged use of the ice is to be avoided since by its use the symptoms are masked. For the same reason analgesics should be administered only with caution and stinginess.

It has been claimed by Politzer and others of his school that the surgeon should not operate, in the absence of symptoms pointing to intracranial involvement, before eight or ten days after the onset of mastoid symptoms, since it takes that time for the frequently disseminated foci of infection to coalesce or to become evident to the eye of the operator. This caution is to be observed particularly by surgeons who do not practice a complete exenteration of the process and cells extending into the zygoma.

With this contention the writer is not in accord. The fact that many cases recover without operation does not balance the lives lost through delayed operation. The three considerations that all cases of acute suppurative otitis media exhibit pathologically antral and mastoid involvement, that cases of intracranial trouble are not infrequent, and that all of the chronic cases which give us so much trouble were originally acute, should determine the earlier and more frequent performance of this very safe and rather easily performed operation.

34 Washington Street.

XIX.

A CASE OF PRIMARY SYPHILITIC INFECTION IN THE NOSE.*

By James T. Campbell, M. D.,

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CHICAGO.

Chancre of the nose is one of the rarest of lesions. Krefting (Archives für Dermatologie und Syphilis, 1894, Vol. 26, pp. 167) gives statistics of 2,916 cases of chancres, of which 539 were instances of extra-genital infection, and Salsetto (Sifilomi Extragenatali et Epidermie di Sifilide, Brochure, Turin, 1892) records 201 cases of extra-genital chancre with no case of primary nasal infection. Bulkley (Syphilis in the Innocent) gives a table of 9,058 cases of extra-genital chancre in which primary infection of the nose occurred 95 times. Bosworth (A Treatise on the Nose and Throat, 1889) states that in 2,244 cases of chancre observed by Bossereau, Clerq, Lefort, Fornier and Ricord, the primary lesion was found twice in the nose. Le Bart (These dé Paris, 1894) reports 37 cases of primary nasal chancre, of which 21 were external and 16 within the nostril.

The earliest recorded case I can find is that of McCarthy (These dé Paris, 1844). Spencer Watson (Medical Times and Gazette, 1881, Vol. 1, p. 428) reported a case of a nurse in attendance on a woman who gave birth to a syphilitic child. The sore could not be distinctly seen, on account of the swelling within the nostril. Severe pain, fever and mental depression was followed by the ordinary symptoms of secondary syphilis. The vehicle of infection, in all probability, was the patient's own finger.

Intra-nasal inoculations occur most frequently in the lower and anterior part of the nasal septum, next in frequency on the ala and then, as in the case I am about to report, on the inferior turbinated body.

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*Read before the Chicago Laryngological and Rhinological Society, Feb. 13, 1906.

The location modifies the chancre's appearance.

On the septum it displays a flat reddish or greenish, fungiform mass with indurated circumference. The surrounding mucous membrane is to a greater or less degree swollen, and there flows from the ofttimes stenosed nostril a bloody, fetid discharge.

When the ala is involved the infiltration and induration often causes it to be of a cartilaginous consistency.

When the inferior turbinated is primarily inoculated the appearance resembles mostly a severe localized influenza, or a fibrinous or diphtheritic rhinitis. Usually the submaxillary, sublingual and preauricular glands early show marked indolent swelling.

Characteristic of this infection is an aggravated general febrile disturbance, malaise and depression of spirits.

The chancre may be mistaken for an abscess of or injury to the septum; for a furuncle to which for a time it is not dissimilar; for vaccine inoculation; for tubercular ulceration; for malignant disease.

The existence of an ulcer in the nose with a peculiar hard base and granular surface, bleeding easily on touch and of limited extent, would suggest tuberculosis, malignant disease or syphilis.

Tubercular ulceration occurs only as secondary to a pulmonary deposit and examination of the discharge would show characteristic bacilli.

In malignant disease glandular enlargement is a late development, and the progress of the disease is liable to be accompanied by profuse epistaxes.

In syphilis the chancre is followed shortly by characteristic secondary symptoms.

CASE REPORT.

HISTORY.—On October 19, 1905, a surgeon in perfect health circumcised a patient on whose prepuce was a large indurated chancre.

On December 16, nearly two months later, he first noticed stuffiness of the right nostril, right-sided headache from brow across vertex to occiput. This was accompanied by malaise, anorexia, chilly sensations and constipation, a condition from which he never before had suffered. For a period of two weeks his temperature ranged from 100° to 100 1-5° F. He had worked very hard for a few weeks prior to December 16, and he attributed his condition to overwork and a grip-like attack. During Christmas week he visited his old home, but the rest did not improve his condition.

EXAMINATION.—I first saw him on December 28, 1905. At that time I made the notation "Superficial necrosis of the mucous membrane covering the anterior end of the right inferior turbinated body; the fibrinous membrane when raised, revealed an ulcerating, bleeding surface." Neither suprarenalin 1-1000 nor cocain solution 10 per cent caused any appreciable blanching or shrinking of the turbinated body. Lachrymation was present on the right side and one gland below the angle of the right jaw was enlarged and tender.

The condition resembled fibrinous rhinitis, but it was limited to the inferior turbinated body and there was no ichorous discharge from the nostril. The swelling practically occluded the nostril, which is narrow on account of septal deviation, the result of traumatism in childhood.

The treatment employed was a cleansing alkaline spray followed by sprays of peroxid of hydrogen and lime water.

COURSE OF DISEASE.—On January 8, 1906, eighty days after the probable inoculation, a macular rash appeared on the abdomen.

Four days later, when I was shown the rash, I made a positive diagnosis of syphilis and was confirmed in this by Dr. Joseph Zeisler and Dr. T. Melville Hardie.

The "lean-ham" macular and papular rash, more marked on his chest and abdomen, covered practically the whole body with the exception of the exposed portions of head and hands. There were papules at the base of the uvula but no soreness or congestion of the fauces and no glandular enlargement or soreness excepting the before-mentioned submaxillary gland. Disappearance of the fibrinous membrane and healing of the ulceration took place under the simple sprays before constitutional symptoms appeared. Coincident with the appearance of the rash the headache ceased and the general feeling of well-being began.

On diagnosis of syphilis being made, inunctions of mercurial ointment, one dram, at bed-time were begun, and after six rubbings all evidences of the disease had disappeared.

1010-34 Washington Street.

XX.

REPORT OF A CASE OF ABSCESS OF THE TEMPORO-SPHENOIDAL LOBE OF AN OTITIC ORIGIN.*

By John J. Kyle, M. D.,

INDIANAPOLIS.

The history of abscess of the brain from chronic middle ear suppuration is quite frequent, and according to Gowers, in 173 cases, 102 were of otitic origin. The percentage of cases of brain abscess, following years after all observable suppuration of the ear has passed away, from a condition of slumbering mastoiditis, would be of particular interest.

The report of the following case is important because it accentuates the necessity for a careful consideration of the history of middle ear disease and its approximate valuation in the diagnosis of acute or chronic brain disease.

Mrs. Mc——, age 36, was brought to St. Vincent's Hospital November 11, 1905, by Dr. Williford of Washington, Indiana, and the following history was given by the husband and Dr. Williford:

No luetic history; married eleven years; no severe sickness during that time; has three children living, all strong and healthy; two children dead, one died of meningitis and the other of uremic poisoning; suffered from an acute inflammation of the right ear nine years ago, followed by a discharge from the ear, which continued for six weeks; no history of any subsequent discharge; recurrent attacks of earache during the winter months; during last three years, each subsequent attack was a little more severe; previous to the last six months, the pain was always in the ear, but since that time the pain has been just above the ear; the pain was constant, at times being a dull ache and at others a severe boring pain.

In April last, the patient suddenly fell with loss of consciousness, followed by a loss of control of the hand and leg of the right side; complete loss of sensation in arm and leg.

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*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society.

This continued for about two weeks, when the patient was able to be about with the assistance of a crutch. The numbness in the arm and leg continued for about two months. For a longer period than a year, the patient has complained of a severe dizziness, with a tendency to fall to the affected side. At times the patient suffered from nausea and vomiting. Following the discharge from the ear, an eczema manifested itself along the right tibia. Upon examination, we found a long scar and two or three hard nodular masses, as though there might have been periostitis at some time. The ulceration on the tibia continued for at least one year. About twelve days before her entrance to St. Vincent's Hospital she became delirious, especially after sleeping. This would continue for quite a while after awakening. Sleep and relief from pain was only secured by the use of large doses of morphin.

When brought to the hospital she was delirious and unable to walk. When I saw the patient she was in great agony, moaning and tossing about the bed. Her speech was incoordinate and unintelligent. Temperature was 97.4. There was no tenderness or swelling discernible over the mastoid; tympanic membrane clear and glistening; light spot normal. The upper lid of the right eye drooped somewhat, with dilation of the pupil and slight convergence. Babinsky's sign was absent; no anesthesia of arms or extremities; optic fundus normal in both eyes.

With the foregoing subjective signs to guide us, the mastoid process was opened. The cortical substance was hard and sclerosed. No discharge was found on opening into the antrum. On exploring the roof of the antrum, the middle cranial fossa was opened without perforating the meninges. The mastoid process was now obliterated as nearly as possible. The whole process was entirely sclerosed with the exception of two small superficial cells the size of a wheat grain. The roof of the antrum and temporal bone in proximity were now removed with a rongeur forcep. A semilunar shaped portion of the temporal bone one-half inch wide, extending forward for one inch, was removed, exposing entirely the meninges. They were found to be of a grayish-blue color, fibrous and tough. The membranes were opened with a pair of scissors. At the site of the opening a pocket was found about the size of an ordinary hen's egg, partially filled with dark blood, pus and broken down brain tissue, indicative of subacute abscess. The broken down substance was partially curetted away. There was no distinct outline to the abscess. The middle ear and aditus ad antrum were hard and smooth, and in consequence the middle ear was not disturbed. Following the curettement of the broken down brain tissue, the wound was irrigated with a normal salt solution and packed with a strip of iodoform gauze. A profuse discharge of bloody pus followed the removal of the gauze on the following day. Microscopic findings from the abscess, when first opened, showed a pure staphylococcus pyogenes aureus infection.

The discharge which now followed each dressing for five weeks was pure pus, varying from a tablespoonful to a slight tinting of the gauze at the end of the fourth week. At the end of the fifth week the wound in the meninges was allowed to close. The closure of the post-auricular wound was uneventful. The patient was discharged from the hospital at the end of the eighth week. The patient was quite irrational for two weeks after the operation. She complained of severe pain in the temporal region, which necessitated the hypodermic use of codein for two weeks, especially at night. After this the pain gradually subsided and all opiates were dispensed with. On account of the old tibial scar, iodo-neucloid in thirty-grain doses was given from the beginning, with instructions to continue the treatment for an indefinite period. The eye symptoms partially disappeared after seven weeks, when, with the aid of glasses, the patient was able to read satisfactorily. The patient was perfectly rational and in apparently good health at the time of leaving the hospital. In walking, the patient showed a slight incoordination, with an inclination to move to the right side. The husband now reports the wife to be free from any brain irritation and in better physical and mental condition than for a year.

By way of explanation of the paresis, we may say, if there is a crossing of the motor fibres, then from this lesion it would be impossible for the lesion in the right tempora-sphenoidal lobe, or right half of the cerebellum, to produce paralysis, partial or complete, in the right arm or right leg alone, as the motor fibers, when they cross, do so in the lower portion of the medulla. While the motor fibers do so cross in the vast majority of cases established, about 95 per cent of all human beings, from a lesion located as in this case, we would, in consequence, have motor paralysis in the left arm and left leg.

This would be equally true if the abscess extended forward and inward sufficiently to affect the right peduncle. In other words, if in this patient the usual decussation of the motor fibers occurred, the lesion found in the right temporo-sphenoidal lobe and cerebellum would not account for the symptoms present, and we would conclude that a second lesion occurred, presumably in the left internal capsule. This lesion might have been embolic, thrombotic or hemorrhagic, and might well have been only temporary in its effect. Let us attempt for the moment, however, to associate the clinical symptoms presented with the existence only of the lesion of the right side of the brain found at the time of the operation. We know from experience that a very respectable per cent of individuals have no decussation of the motor fibers, but that they take a course from the cerebral hemisphere to the extremities of the same side of the body, instead of crossing to the other side, and it is not beyond reasonable conjecture that in this patient this anatomic condition existed. If this were actually the case, it is not difficult to conceive that pressure from the abscess in the right temporo-sphenoidal and cerebellar region could be sufficient to produce symptoms from the right peduncle and upper pontine regions, causing motor paralysis upon the same side of the body, by reason of the fact that the usual motor decussation was absent. When we consider that the sensory and motor symptoms of right arm and right leg were of a comparatively transient nature, and had practically passed away upon our first examination of the patient, it is more reasonable to assume that the paralytic symptoms were not due to the abscess in the right sphenoidal region, but to an acute hemorrhagic embolic process in the left internal capsule. In other words, we had at one time two lesions, primarily the abscess in the temporo-sphenoidal lobe, and a transient secondary extravasation in the left internal capsule.

XXI.

INDICATIONS AND CONTRAINDICATIONS FOR INTRALARYNGEAL OPERATION IN TUBERCULOSIS OF THE LARYNX, WITH REPORT OF THREE CASES.*

By Cullen F. Welty, M. D.,

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AURAL SURGEON TO THE CITY AND COUNTY HOSPITAL.

Because of the climate of Southern California, a great many people with tuberculosis of the lung make this their permanent home. Others who are not so fortunate come to this climate during the time of the disagreeable weather at their own homes. Because of this fact, the laryngologists of this section have an exceptional opportunity of observing these cases of laryngeal tuberculosis, and it is for this reason that I present this paper at this particular place.

The percentage of laryngeal tuberculosis in lung tuberculosis is estimated very differently by different observers. M. Schaffer, 97 per cent; Lubinsky, 60; Froumel, 40; Morrell MacKenzie, 34; Heinze, 30; Schech, 30; Gaul, 27; Frey, 26; Krieg, 26; Buhl, 16; Willigk, 14. Probably about 33 1-3 per cent would be a fair average. Age, between 20 and 40 years. More male than female. Seldom under 12 years.

It is well to mention at this place the various pathologic lesions that are likely to be found in this class of patients, that demand surgical interference (in order of frequency).

First—Edema of the arytenoids and epiglottis. Second—Thickening and ulceration of the posterior laryngeal wall. Third—Infiltration and ulceration of the false cords. Fourth—Ulceration of the epiglottis. Fifth—Thickening and ulceration of the true cords. Sixth—Granulometa supported by a pedicle should be removed in all cases.

Heryng and Krause are probably the most radical operators in the world, Herying, the most radical of all, operating all cases. Morris Schmidt and Sheck are somewhat less radical than the former. However, they find a few more indications for operation than Hajek.

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*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

For convenience I have made a classification that may help somewhat for getting at the various indications for intralaryngeal operation.

Laryngeal Tuberculosis	Primary	All operated.		
	Secondary	Without laryngeal symptoms	Do not operate.	
		With laryngeal symptoms	Active	Operate only to make the patient more comfortable.
			Passive	Operate to cure the patient.

Tuberculosis of the larynx divides itself very naturally into primary and secondary affections. By primary affection we mean that tuberculosis does not exist elsewhere in the individual. These cases are rare and very difficult of diagnosis. Once certain of the diagnosis, the only thing to be thought of is operation. The more radical the operation, the more chance the patient has for complete recovery.

By secondary affection we mean that there is tuberculosis elsewhere in the body, and that this local manifestation of the disease has been brought about in one of three ways (in order of frequency), lymphatics, blood, expired air and mucus.

The secondary affections are further divided into those without laryngeal symptoms and those with laryngeal symptoms. By laryngeal symptoms I mean pain, cough and dyspnea. Pain may be so intense that the patient will not swallow and from necessity will not eat. It does not take long to reason what will naturally follow. Pain usually induced by edema and ulcerations. Cough may be so severe that it continues to add to the already inflamed and thickened mucous membranes. Cough is primarily induced by ulcerations, edema and mucus secretions. Dyspnea may be so severe that it alone threatens life. When it is so marked as this, the only safe procedure is a primary tracheotomy. The cause of the dyspnea will usually subside with the rest that naturally takes place to the larynx following tracheotomy. Dyspnea is usually induced by edema and infiltrations.

The cases without laryngeal symptoms we do not operate upon, because the local condition is not causing any inconvenience or annoyance. It occasionally happens that individual cases may change their grouping as the disease either progresses or improves. However, there are many cases in this class that recover completely without surgical means.

The cases with laryngeal symptoms are further divided into active and passive. By active I mean that the tubercular process in the lung is more or less active, that the patient has a temperature of more than 100° F., and is losing weight rapidly. By the passive I mean that the tubercular process is more or less quiescent, temperature below 100° F. and only slight loss of weight.

In the active classification the patients are only operated to be made more comfortable. You do not operate to save the life of individuals. However, you can assure them with certainty that they will be more comfortable the balance of their lives. Some of the cases so operated seem to be followed by a more active manifestation of the primary affection. Heryng, Krause and others think this is simply a coincidence, while others, notably among them Hajek, think this is directly caused by the operation. This condition does happen, and we should be prepared for it, as the patients die in a few days. However, most of the cases so operated feel so much better that they entertain hopes of complete recovery. Usually the lung condition goes on the same as before, and the remaining days are free from laryngeal symptoms, which adds very much to the comfort of the individual.

In the passive or the quiescent condition, a great deal may be accomplished by intralaryngeal operations, in fact, they are the cases of selection. In these cases we operate to cure the local condition, and in many instances this is accomplished. By destroying the field of infection the cases may entirely recover. It is assumed that the tuberculosis of the lungs is in a quiescent condition, and by such an operation you place the patient in the best possible condition for complete recovery, because the field of infection has been destroyed. In fact, so much can be said on this particular phase of laryngeal tuberculosis, that chapter upon chapter has been written upon the subject. Pain is very important in this classification and must be relieved. Cough is more important under this heading than in the preceding, because it is usually induced by the local condition. Should the cough be allowed to continue, the chances of renewed infection are increased.

If dyspnea is present, an intralaryngeal operation should not be attempted, because the added irritation from the operation will so inflame and congest the parts that there is danger of suffocation from laryngeal stenosis. In such cases a primary tracheotomy is always indicated.

A short time ago I noticed an article in one of the special journals recommending intubation in such cases. I only mention this to condemn it.

About four years ago I was fortunate enough to see a case of laryngeal tuberculosis suffering from dyspnea, which was induced by infiltration of the false cords and thickening of the posterior wall.

The thickening of the posterior wall was removed, and the patient was requested to wait for an hour. One-half hour after the operation there was complete stenosis of the larynx. A rapid tracheotomy was necessary to save the life of the individual. This case was so instructive to me that I will never do an intralaryngeal operation if dyspnea is present.

Sometimes, following an operation in this passive group, the patients seem to have a renewed infection with rapid rise of temperature, lose weight rapidly; in fact, all the symptoms of an acute exacerbation of the old lung condition. This lasts for a week or two, and they gradually get back to their former condition. Their improvement is largely dependent upon the condition of the lung, and upon the complete removal of the tubercular process in the larynx. I have not seen any of these patients die for months following.

Partial or complete removal of the larynx for laryngeal tuberculosis I mention simply to condemn, because it is not necessary, and because the mortality of such an operation is of necessity very high, and because the laryngeal disease is only the local manifestation of tuberculosis elsewhere.

You no doubt have noticed, and will probably take exception to, the fact that I have not spoken of the tubercular process of the lung. If you follow this classification of laryngeal tuberculosis you will find that it is unnecessary, and you will be able to recommend different procedures regardless of the lung condition.

I do know that a great deal of good can be accomplished by the proper procedure. I have arrived at these conclusions by personal experience of four years along this line of work. I have operated on thirty or forty cases, comprising eighty or ninety different operations. I have also had the opportunity of observing three times this number of cases, and these observations have led me along the enthusiastic line of which I speak.

Case I.—Male, age 29, undertaker by occupation, married, two healthy children, wife in good health, father mother, two brothers and one sister well and healthy; one brother died of tuberculosis at the age of 25. The patient has been perfectly healthy until two years ago, when he began to lose weight and had a slight cough. This cough has increased to such an extent that he is coughing practically all of the time. During the last year he has lost about 25 pounds, has an occasional night sweat, his temperature does not reach 100° F. On laryngeal examination, I find decided thickening of the posterior wall, which is ulcerated; slight edema of the arytenoids. Removal of the posterior laryngeal wall, cauterized with 80 per cent lactic acid. For the next thirty days there was not so much cough, and apparently he was much improved. Up to this time he remained in San Francisco attending to his work, which necessitated his being out a great deal at night. Six weeks after the first operation he had high fever, night sweats and rapid loss of weight, and a cough that was almost as severe as when he first consulted me. At this time there was decided edema of the arytenoids, which was not interfered with. The patient was sent to the mountains, where he would be in the open air the whole twenty-four hours. Returned in one month somewhat improved, occasional night sweats; was not losing weight, was not gaining; temperature 100° F. The cough seemed to be the only annoying symptom of which he complained. The arytenoids were more edematous than before. I scarified, which gave him relief lásting for ten days. He returned to the city at the end of thirty days in practically the same physical condition that he was in thirty days before. The edema was considerably increased; it was increased to such an extent that I advised a tracheotomy at once. He had considerable dyspnea and almost complete stenosis. He would not submit to operation, so I told him I could not continue to treat him if he would not follow my directions. He died some six or eight months later.

Case II.—Female, age 38, married, three healthy children, husband healthy, her family history negative, poor hygienic surroundings. Healthy until one year ago, then she developed a cough and lost weight rapidly, had night sweats and daily temperature. In about three months was very much improved and gained some weight, did not have night sweats; no temperature. The cough continued and she began to have pain in the larynx. The pain in the larynx has persisted, and in fact has grown more severe in the last month; at times the pain is so severe that she can scarcely swallow. She would like to eat, but will not, because of the intense pain. A decided thickening of the posterior wall, with an ulcerating surface, was found; this was removed the following day and cauterized with 80 per cent lactic acid. The day after the patient began to eat and has had no laryngeal symptoms since. She gained twenty pounds in four weeks, and from appearances is perfectly well.

Case III.—Male, age 42, clerk by occupation, married, no children, never robust, however, was never confined to bed by illness; parents, brothers, sister and wife healthy. About one year ago he had influenza, from which he did not completely recover. It left him emaciated, weak and with a cough. He had daily temperature, night sweats occasionally. About six months after his attack of influenza he began to experience pain in the larynx when he coughed. This pain increased gradually for three months, until he consulted me. He said that it was so painful for him to swallow that he had not swallowed a thing for five days; besides this, he had night sweats, losing weight rapidly. The cough at this time was very persistent and would prostrate him very much because of the pain induced.

Examination.—Half of the epiglottis had been destroyed by the tubercular ulceration, otherwise the larynx was reddened. I told the wife what I found, what I proposed to do, and what would happen. They insisted that I should proceed at once, which I did, removing the ulcerating surface of the epiglottis, which included practically the whole of the epiglottis. cauterized with 80 per cent lactic acid. I then gave the patient two glasses of malted milk, which he drank with a relish. In a few days he was taking semi-solid food; in the course of a week he was taking solid food. He began to have some pain about ten days after the primary operation. On very careful examination

I discovered a few points of granulation tissue in my former field of operation. They were removed, and their surfaces cauterized by lactic acid. The only annoying symptom that this patient had after the primary operation was the accumulation of mucus in or about the larynx. This was relieved by an alkaline spray. The patient lived sixty days from the time of the first operation. So far as his larynx is concerned, he was perfectly free from all laryngeal symptoms, which no doubt contributed much to the comfort of his remaining days.

606 Sutter St.

XXII.

MOUTH-BREATHING IN RELATION TO MENTAL AND MORAL HYGIENE.*

By Ross Allen Harris, M. D.

LOS ANGELES, CAL.

The philosopher-doctor who declared "The first condition of a successful life is to be a good animal," also affirmed "A sick man is a rascal."

In spite of numerous exceptions that test the rule, we not only find but expect to find a sane mind in a sound body, and a mind diseased in some particular, in an unhealthy body.

Of all the elements, oxygen and hydrogen in the form of air and water are absolutely essential to our existence. A man may live for a month or more without food, for three days without water, but not longer than a few minutes without air.

The all-wise Artificer has given us one mouth for the reception of food and drink, but two nostrils for the admission of air. If one nostril be stopped the other stands ready to do the work of two. If both be occluded, the mouth must needs take up a task unnatural and undesirable to itself.

The mucous membrane of the nose is eminently adapted to repel invasion by bacteria. Its cilia sweep them out as a new broom scatters dust. Its secretion will drown or collect and dessicate them. Dust and small foreign bodies are ordered back by the fine sentinel hairs. The inspired air is warmed and filtered.

A dozen micro-organisms are always normally present in the mouth. They may be numbered by millions in filthy mouths.

The saliva—the combined secretion of the various glands opening into the buccal cavity—varies from two to three pints daily. Aside from its mechanical effect in constantly flooding the oral cavity, it possesses undoubted bactericidal properties.

Nature has thus wonderfully provided against infection. Yet given a *locus minoris resistentiae*, a solution of continuity, plus the virulent micro-organism and we have the entity called disease.

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*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

The mouth-breather inspires dust and microbe-laden air, and dries too rapidly the moisture of the mouth. The immediate result is a turgescence and hypertrophy of the mucous membrane, followed eventually by atrophy. Dr. Henry Green speaks of a man who contracted conjunctivitis from the action of a draft through a keyhole upon his eye. The mouth-breather has a constant draft upon his pharynx, drying and chilling it. In this way contagious disease of every sort may be contracted, not only the catarrhal but the exanthematous.

Campbell reports three cases of iritis in which there was an absolutely negative history of either syphilis or rheumatism, but in all three there was a marked evidence of oral sepsis.

If pneumococci, or tubercle bacilli be absorbed through pathologic openings in the mucous membrane of the mouth, or swallowed in a bolus of mucus, they are carried to the lymph-nodes of the neck or the lungs. The inflammatory reaction of pneumonia or tuberculosis results.

At Portland the declaration was made that not a few of the affections of the heart valves, ordinarily attributed to rheumatism, resemble those produced by septic conditions much more closely than had been imagined. Marshall says that 90 per cent of all compound fractures of the jaw suppurate.

It is in the throat that we find local manifestations of many constitutional diseases, as influenza, diphtheria, varicella, measles, scarlet-fever, smallpox, and here it is that actinomycosis has its native dwelling place.

The causes of mouth-breathing are manifold, adenoid growths in the nasopharynx being the commonest; deflections of the nasal septum; hypertrophy of the turbinate bodies; acute or chronic catarrh; nasal polypi and neoplasms.

The diagnosis of mouth-breathing is not always easy. Of course, the facies of the common victim of adenoids and hypertrophied tonsils is ever characteristic. The drooping jaw, narrow and inactive nostrils, lustreless eyes, the partial ptosis, the crowded teeth are so diagnostic as to scarcely require mention.

But careful scrutiny will discover that many an active, bright-eyed boy or girl breathes habitually with parted lips. These intelligent youths may progress just so far in school, but will then seem to be unable to make further advancement.

The fault is laid to nervousness, to defective eyes or to innate depravity. The nervousness is attended to by drugs containing more or less alcohol; the depravity by nagging or stupid punishments; the eyes may be fitted with quarter-diopter spherical lenses. All myopia and all astigmatism should be most accurately and constantly corrected, but the average healthy American child should be able to easily overcome one-half a diopter of hyperopia, and this action of a normal accommodation will be all the more wholesome for his future vision.

Should the drugs, the scoldings and the optician have failed to improve our patient, let us examine him as to catching cold easily, snoring, night-restlessness, a dry throat on waking, and finally with the nasal speculum, the laryngoscope or the visual organ in the tip of the index finger.

Is the mouth-breather doomed to a life-long continuance of his habit? Not if the cause be adenoids or hypertrophied tonsils. As the years pass, usually at puberty, these morbid growths will atrophy and practically disappear. Would that the harvest of their sowing might go with them. But the horrid crop remains.

The chronic nasal catarrh, the atrophic rhinitis, the mephitic ozena, the dread suppurative otitis media, or the great white plague have begun or done their fearful work.

As sequelae to these direct physical effects, and following their debility and exhaustion, are exhibited anemia, indigestion, insomnia, constipation, and rheumatism—that happy term covering a mountain range of our ignorances. And these diseases are the prophetic forerunners of neurasthenia, the neuroses and the psychoses. The mouth-breather being out of harmony with his environment, his moral nature is bound to become perverted.

As one in every ten among the school children of our large cities will be found to be a mouth-breather, and one in five will be found to have enlarged cervical glands, we would urge the following remedies:

1. Monthly inspection of all public schools and juvenile institutions by competent physicians.
2. School instruction regarding the causes and results of mouth-breathing, with lessons in the hygiene of the mouth and nose.
3. The urging by physicians of speedy operation whenever this condition is encountered.

The mental and moral effects of the removal of the commonest cause of mouth-breathing was first commented on—not by a member of the medical profession, but by a layman, Mr. Edward A. Huntington, principal of a special school in Germantown, Pa.

To his instructive list of reported cases I would add these few, to call attention again to the baneful influence of this unfortunate habit upon dispositions and character.

Case I.—Charles W. Age 8. Always a mouth-breather. Catches cold easily. Chronic suppurative otitis media for six years in left ear. Enormous faucial tonsils, almost meeting together in the throat. Large adenoid mass in post-nasal space. Mother says the boy is very nervous and irritable. Cannot keep still in school. Is often kept after school for punishment. The teacher sent home a note saying the boy was always fighting.

The boy is a center of mischievous activity and cannot keep his friends long. Cries and laughs very easily. Is constantly moving hands, feet or tongue.

Operation, double tonsillotomy and adenectomy. Operation for otitis media refused. Patient's improvement in general health and in school was very encouraging for one year, though he suffered much from recurrent sore throat and breathed most of the time with open mouth. This was supposed to be a continuance of the life-long habit, but examination showed both tonsils again enlarged, the left one especially so. This one being removed while acutely inflamed the entire throat became better, though the mouth-breathing continued. The pus from the suppurating ear was examined at this time. It showed only "dead" cells of staphylococcus aureus, no streptococci being present.

The mother tried to bring about a good habit of mouth-breathing by a sort of cloth bridle which bound up the chin with buckle and strap. The device never proving very satisfactory, a strip of court plaster was pasted across the boy's lips on retiring. This effected the purpose indeed, "not wisely, but too well." Hearing strange sounds one night she entered the room where the boy was sleeping and found him writhing in a convulsion, with vomitus pouring from his nostrils. She tore off the plaster as quickly as she could (it isn't easy to remove court plaster, either) and the pillow was deluged with the remains of a hungry boy's supper, together with a quantity of popcorn he had eaten in the evening. The boy might have been drowned by his own stomach but for this timely intervention.

The attempt at mechanical closure of the lips was abandoned, and moral suasion tried while the boy was awake, with a low pillow while sleeping.

Today the boy is a healthy-looking lad who breathes through his nose most of the time. His last deportment card in school was marked "Excellent," and almost every study showed "Good" or "Excellent." He is a manly boy, with ideals high enough to make him a favorite with teachers and playmates. He bids fair to become a useful and healthy American citizen.

Case II.—Helen G. Age 4. For two years it has been my privilege to observe this child who, but for her affliction, might well be termed a degenerate. Is not degeneracy the result of faulty habit and environment, as well as of heredity?

She is a fair-skinned, tow-haired, well-developed daughter of refined and wealthy parents. General health excellent, but always breathes with open mouth. Is sick in bed with a cold or tonsilitis every month or two. Is highly imaginative, and untruthful insomuch that her mother cannot permit her to attend Sunday school, for on her return she will invent the most impossible fictions that a morbid mind could conceive.

Her play with other children invariably ends in woe to her playmates. She is cruel. She says "I like to slap your little girl because I like to hear her cry." She is undutiful. When her mother calls her she refused to answer, remarking, "She doesn't really want me, she is just calling because she doesn't know what else to do." And, "I like to make Mary do things you don't want her to do, so she won't mind you." She is vindictive. When reproved by a neighbor she threw stones at the baby, saying she hoped one of them would kill it. Insolent to passers-by, strangers wonder at her insulting remarks or gestures. Obscene to a degree, she is the horror of every parent in the neighborhood. When she entered school last September the teacher, glad of any excuse to oust her, declared that as she could not write she must be put in the kindergarten. She is as unwelcome there; and altogether the case is a pitiful one. Her father will not entertain the idea of an operation on a child so young for a habit which she will certainly outgrow!

Case III.—Hazel P. Age 11. This very elegant young lady appeared with her mother at the Eye Clinic of the Medical College, U. S. C., for refraction. Her attire was so startling in a free dispensary that its description may be pardoned. The latest coat, a large Gainsborough hat, white kid gloves, patent-leather shoes, and well-powdered face completed an extraordinary and unattractive picture. The mother said her daughter had always been nervous, had headaches "across her nose," caught cold easily, was irritable and could not study. The family physician thought she would be benefited by wearing glasses.

Nervous she certainly was. All children are naturally farsighted, but the most painstaking examination of these eyes showed only a trace of hyperopic astigmatism, for which she would accept no correction.

But the crowded and prominent front teeth, the parted lips, the constant sniffling, the high-arched palate, and finally the large adenoid vegetation discovered in the roof of the pharynx, showed the true cause of her nervousness. Transillumination showed both frontal sinuses dull, and this child was only eleven!

I said, "Madam, your child does not need glasses, but she does need an operation," the nature of which was explained to her. "Oh," she replied, "that mouth-breathing is only a habit. She will outgrow that. I have talked to her a great deal about it, and told her how it looked, and she isn't nearly as bad as she was."

Arguments and prophecy were alike unavailing, and the pair departed firmly antagonistic to doctors who always wanted to "operate."

How about the future weal of this child?

Case IV.—Loren S. Age 12. Has always been a mouth-breather. As soon as he recovers from one cold, he catches another. Snores a great deal. Will not keep covers on the bed at night. Irritable. In school his progress was never satisfactory. Loved to tease younger children, especially his brothers and sisters.

Nose was unusually small and ill-developed, even for a mouth-breather. Alae short and flat. Roof of mouth not especially high. Large faucial tonsils and adenoids. Uvula elongated. Operation on these abnormalities was followed by great improvement in demeanor and in school reports. But the mouth-breathing persisted. The court-plaster method of cure was in vogue at the time (it was before the disastrous experience of Case No. I). The mother tried it faithfully. She said she was alarmed one night by the weird, unnatural sounds coming from the boy. She found him tossing, moaning and somewhat cyanotic but still asleep. She took off the plaster and the boy became quieter. It would seem as if Nature cries out for just so much oxygen and will have it whether by nose or mouth.

Loren has practiced nose-breathing by running a block with closed mouth. Gradually increasing the distance, he has not only overcome his bad habit, but has developed sturdy legs and lungs.

At this writing, two years after operation, this boy, now 14, has just bloomed into a virile manhood. He is first assistant to a busy mechanical engineer, who tells me he is the best man in his employ and will make a successful engineer.

Case V.—Mrs. G. H. D. Age 72. Earache for several nights. Tinnitus aurium constant. Catches cold very easily. Frontal and temporal headaches. Tonsils were removed 62 years ago. Catarrh for many years. Used to cry with earache when a child. Has been treated in every large city from Washington to San Francisco. Great, green, decomposing and foul-smelling crusts partly occlude both nares. Frontal and maxillary sinuses dark on transillumination. The sense of smell has been entirely lost for years. Breath fetid. Watch heard in right ear at eight inches; in left ear at eighteen inches. Both tympanic membranes retracted.

The earache soon subsided under hot irrigation, but no amount of cleansing and stimulating treatment served to do more than alleviate temporarily the nasal symptoms.

This venerable and venerated lady is convinced that she was a mouth-breather during the years of her childhood, and to this she attributes her present condition. Her ozena annoys her no more than it does other people. "Isn't it strange," she said to a friend, "that with all my catarrh there isn't any odor?" With averted head her friend answered that it was. Possessed of ample means, she could choose any hotel in the city for an abiding place, or would be welcome at her only son's palatial home in a distant town. But, self-exiled, she lives alone in a single room, doing light housekeeping over a kerosene lamp-stove.

"It's a very poor arrangement, this dying," she avers. Afraid to die, without comfort or hope, she flits about from house to house, never keeping the same address long, but always attended, wherever she moves, by this fearful "old man of the sea."

DISCUSSION.

Dr. B. F. Church, Los Angeles, congratulated the essayist on the able manner in which he had covered the subject. He was especially interested in the case histories.

Dr. H. L. Wagner, San Francisco:—Mouth-breathing was interesting from anatomic, physiologic and psychologic grounds. He spoke of ethmoidal sinus, the lymphatic vessels and the offertory nerves and the manner in which they made their way through the cranial bones and referred to the work of Rensallers of Danzig. The laity will more willingly consent to operations once they are educated to their value in these conditions. Cited cases in the literature, all men and all drunkards, who after adenoid operations, became raving maniacs, showing close connection between nose, throat and brain.

Dr. A. L. Kelsey, Los Angeles, felt that Dr. Harris' paper should have been presented before general practitioners, since it is the general practitioners who see these cases first, and as the general practitioners are only too apt to hold to the belief that the adenoids nearly always atrophy as the child grows older, such a paper as Dr. Harris' would have rendered valuable aid in disillusioning their minds of such a fallacy. He spoke of three post-adolescent patients all well on in the prime of life, on whom he had operated for adenoids.

Dr. C. F. Welty, San Francisco, spoke of the tonsillar and pharyngeal tissue as the entrance way of infections such as tuberculosis. He cited case of a recent patient, a boy of 14, in whom tonsils had been removed by another practitioner; the operation, however, being followed by suppurative processes. An acute nephritis accompanied the local disturbance, but disappeared as the suppuration ceased.

Dr. E. W. Fleming, Los Angeles, stated that there were patients with adenoids in whom general condition was good, but who were troubled greatly by the mouth-breathing, and with whom it was, very hard to get a good response from treatment. These patients are usually children, ages 4 to 10, who possess a decidedly V-shaped and narrow, hard palate. In such patients, even after the removal of the post-nasal obstructions, mouth-breathing may continue. The difficulty in dealing with the hard palate makes brilliant operative results in these cases impossible.

Dr. H. Bert Ellis, Los Angeles:—Referring to the class of patients mentioned by Dr. Fleming, stated that it was his custom to send all such to a dentist after his own work had been completed.

Dr. Ross Harris, Los Angeles, referred to the saying of Dench, he thought it was, who made the statement "Every cold in a child is due to an adenoid." No child was too young to be operated upon. His paper had not been intended to be technical, but was intended rather to show the disastrous effects of non-interference at the proper time. The importance of early operation in this class of patients cannot be exaggerated.

XXIII.

AN OPERATION FOR THE PAINLESS AND BLOODLESS REMOVAL OF SUBMERGED AND ADULT TONSILS.*

By Francis B. Kellogg, M. D.

LOS ANGELES, CAL.

The procedure which I am about to describe is in reality a modification of Pynchon's galvano-cautery dissection. In the modification, however, the role played by the cautery is less important than in the original.

Indications:—It is especially effective in the removal of the so-called submerged tonsil. It also has obvious advantages in the removal of adult tonsils of any class. It is in the removal of the adult tonsil that troublesome hemorrhage is most often met, and it is a matter of no small moment to be able to practically eliminate this disquieting feature.

The operation is also well adapted to the cases of submerged tonsillar stumps which are not infrequently left after tonsillotomy in children. These stumps do not usually require attention until the child has attained sufficient age to co-operate with the physician; a very essential condition precedent to the operation.

Technique of the Operation:—The tonsils and pillars are first brushed with a 10 per cent solution of cocain to secure superficial anesthesia. A few drops of a mixture of beta-eucaine lactate 12 per cent, and adrenalin 1-1000 equal parts is then drawn into a Pynchon tonsil syringe. The needle is pricked through the membrane of the anterior pillar at its middle point, and a drop of the mixture injected under the membrane.

Care must be taken not to prick through the pillar. If the membrane only is penetrated a bleb will be raised by the injection. This is repeated above and again below to cover the entire pillar. If the prick of the syringe is slightly felt at the first injection, the second and third are not felt, as a result of the first.

The anterior pillar is injected for the reason that it is liable to be touched by the cautery, and is much more sensitive than the tonsil itself.

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*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

After injecting the pillar, the needle is plunged into the stroma of the tonsil at different places, and a very little of the mixture injected at each point. Here, too, care must be taken that the point of the needle does not terminate in a crypt from which the anesthetic escapes into the throat. In the latter case it can be seen running out. The tonsil after injection presents a pale, bloodless appearance. Personally I have used a mixture of equal parts adrenalin 1-1000 and cocain 10 per cent, and have never had any constitutional symptoms except in one case, that of an anemic wash-blond of a decidedly neurotic type. In this case the threatened syncope was averted by prompt measures. Since learning of beta-eucaine lactate, however, I would recommend using it in place of cocaine as the safer agent.

The tonsil is now seized with volcellum forceps at the upper third and drawn out of its recess, and at the same time pushed slightly back toward the pharynx to put the attachments to the anterior pillar on the stretch. A galvano-cautery knife at white heat is now entered at the top between the tonsil and the anterior pillar and passed downward, hugging the tonsil, and separating it well from the pillar. The tonsil is then drawn inward and forward and the process repeated on its posterior aspect. At the upper part the cautery dissection is carried deeper, as it is important to completely separate the tonsil from the supratonsillar fossa. In this manner the tonsil is partially enucleated by the cautery. Instead of being a sessile body it is now pedunculated simply being attached to its bed at the base. At this point the cautery is abandoned, and the loosened tonsil drawn into the fenestrum of a Mathieu's tonsillotome, and the enucleation completed.

A Mackenzie tonsillotome would be equally efficacious, and a wire snare would perhaps be better than either. It would still further preclude the possibility of hemorrhage, although it would probably increase the reaction.

I have never seen any tendency to secondary hemorrhage after this operation, and believe it to be effectually prevented by the cautery, while the primary is taken care of by the adrenalin and cautery combined.

I have used this operation upon children as young as ten years of age, and had them come up smiling for the second tonsil a week after the first.

It is the proper treatment for diseased adult tonsils with a tendency to cholesteatomatous accumulations in the crypts.

DISCUSSION.

Dr. W. H. Roberts, Los Angeles, said he never attempted the cautery, but advocated the snare. He thought the snare safer, as the tonsillar artery might be large; used ether as an anesthetic and operated always with the patient in the sitting position.

Dr. W. D. Babcock, Los Angeles, agreed in the use of the snare and thought the cautery unnecessary.

Dr. E. W. Fleming, Los Angeles, thought it difficult under general anesthesia to use the cautery, and that children resent an operation without anesthesia. Referring to Dr. Miller's paper, he considered tonsils as portals of tubercular and other infections, and that when diseased their removal was indicated. Many tonsils were diseased even though they did not seem to be enlarged or prominent.

Dr. C. F. Welty, San Francisco, referred to the rheumatic symptoms from tonsilitis, being additional indications for their removal.

Dr. H. L. Wagner, San Francisco, stated that he had made investigations, while in Wurzberg, of the tonsil and adenoid, both as to their structure and their absorption properties. He believed that they were fetal structures, and as such have no office to perform in after life. He had confirmed the experiments regarding the transmission of colored particles, and said the tonsil is, as it were, a lymph heart. He expected to show at the next State meeting a dog's lung, in the apex of which are colored particles that were absorbed by the tonsils and transmitted to the lung.

Dr. Hill Hastings, Los Angeles, quoted a report of Dr. A. J. Lartigau from the Pathological Department of the Columbia University, who made a study of hyperplasia of the tonsillar tissue, especially in reference to the possibility of tuberculosis infection. Dr. Lartigau's conclusion were: "Primary tuberculosis of adenoids is probably more common than most previous studies show. Sixteen per cent of our series contained tubercle bacilli, 10 per cent with characteristic lesions of tuberculosis. The tubercle bacilli were present in small numbers. The lesions in primary tuberculosis of the adenoid are generally close to the epithelial surface and focal in character. Occasionally they may be found in the deeper parts of the pharyngeal lymphoid tissue. It is probable from our experience that many later investigations will show primary tuberculosis in 10 per cent or over of the clinic cases."

Dr. H. A. Kiefer, Los Angeles, emphasized that a complete removal of the tonsil is a difficult operation and that a rheumatic history is often found in chronic tonsillitis.

Dr. F. B. Kellogg, Los Angeles, said that there are advantages of an eschar. The cautery causes a sear which most effectively destroys tonsillar tissue that might be left by a cutting or snare operation. The soreness is never more than from the use of a knife, for the cautery only separates the adhesions.

XXIV.

SECTION OF TEMPORAL BONE; TEMPORAL BONE OF CHILD; METAL CAST OF EAR.*

By Hill Hastings, M. D.

LOS ANGELES, CAL.

Dr. Hastings presented the following specimens for inspection and consideration:

1. A section of the temporal bone showing productive osteitis of aditus and antrum.
2. The temporal bone of a child at birth, showing the high position of antrum and exit of the facial nerve.
3. A metal cast of the ear, including the mastoid cells, cochlea and semicircular canals.

The last specimen, he said, was one of many he had made, most of them having been failures, and was almost perfect. He said that he had made the casts after Politzer's method, but found it was necessary to bore a hole in the superior semicircular canal to provide an air vent before pouring in the hot metal through the meatus. Otherwise the labyrinth was not completely filled. The child's temporal bone, he said, showed another point, namely, the mastoid-squamous suture, in which was situated the antrum. He wished particularly to state that it was a misconception to regard the antrum as a part of the mastoid process. It is rather a part of the middle ear, as was shown by the specimen. Furthermore this conception, which was by no means original, he said, is significant in getting a correct idea of inflammatory conditions of the middle ear. The general practitioner is apt to believe that when the "mastoid antrum" is involved in the course of a suppurative otitis, the ear trouble is then dangerous. As a matter of fact, he believed that the antrum, as a part of the middle ear, is inflamed in every case of suppurative otitis media. Its mucous membrane lining is continuous through the short aditus with that of the cavum tympani, and it is quite unreasonable to suppose that a suppurative inflammation of its mucous membrane should stop at an imaginary boundary line between the tympanic cavity and antrum, and that the antral mucous membrane would remain normal.

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*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

If this fact is generally known, the necessity for an early incision of the drum membrane will be more impressed on the mind of the general practitioner, as the best abortive measure against mastoid involvement.

XXV.

EUSTACHIAN CATHETERIZATION THROUGH THE MOUTH, WITH REPORT OF AN ILLUSTRATIVE CASE.*

By Hugo A. Kiefer, A. B., M. D.

LOS ANGELES, CAL.

Eustachian catheterization via the oral cavity is a method we meet with but very seldom in actual practice. I have met with only a few gentlemen who professed to use it. It is a method not to be recommended for the ordinary run of cases requiring catheterization, as the methods of Kramer, Deleau and others, utilizing the nasal passages as a way of ingress, is much easier of performance and requires less time. But it is too valuable an adjunct to be deserving of the extreme neglect that has been accorded it. We meet with occasional cases in which the methods above named cannot be utilized on account of nasal obstructions, and for such cases it is very fortunate that we have recourse to the method under discussion.

The technique is not difficult, and can easily be acquired by any one skilled in the use of the rhinoscopic mirror. The oro- and naso-pharynx and soft palate should first be anesthetized. The patient then depresses the tongue with an ordinary depressor, the surgeon manipulates the mirror with one hand, and with the other hand inserts the catheter into the orifice of the Eustachian tube, using for this purpose a metal or rubber catheter (I prefer silver), which should be bent in a long curve at the distal end to almost 90 deg. from the shank. Then withdrawing the mirror and laying it aside, he can use that hand for the manipulation of the Politzer air bag, which should be armed with a rounded hard-rubber tip, which will fit in and close, but not wedge in the orifice of the catheter. The principal difficulty lies with patients who cannot relax the palate sufficiently to afford a view of the nasopharynx. This difficulty, when it exists, can usually be overcome by a little training and persistence, and the use of a local anesthetic, though there are some cases in which it seems impossible to accomplish this. The palate retractor may be tried in such cases.

Incidentally it can be said that this method is cleaner and involves less danger of carrying infective material into the middle ear than when the catheter is carried through the nasal chambers. How often on passing a catheter through a nose apparently well cleansed, and withdrawing it again without forcing air through, may we find a plug of mucus obstructing its lumen.

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*Read before the Western Section of the American Laryngological, Rhinological and Otological Society.

The following case will illustrate about the class of patients to whom I would, and do, restrict the use of this method:

J. C., aged 38, farm hand, presented himself for treatment of the right ear, which troubled him with "fullness," and "ringing," and "some pain" for two days past. Contracted a cold in the head one week before this, from which he had almost completely recovered. General health good. Has always had difficulty in breathing through the nose. The right tympanic membrane is bulging, transparent, slightly injected at the margins and presents evidence of serous fluid behind it to the level of the umbo. Very little tenderness at the tip of the mastoid; Rinne negative; temperature 99° F. Simple chronic nasopharyngitis, with some evidence of the recent coryza. Both of the middle and inferior turbinates are much enlarged; a cartilaginous and bony spur on the right side of the septum; deflection of the cartilaginous septum to the left.

Repeated attempts at Politzerization failed after the application of adrenalin and cocain to the orifice of the Eustachian tube; catheterization of the tube through either nasal chamber impossible on account of the nasal obstructions. Catheterization through the mouth was tried, after cocainization, with perfect success and the tympanum inflated. This was practiced daily for a period of six days. Thereafter inflation became possible by the Politzer method, which was employed every other day for ten days, the patient making an uneventful recovery.

It may be added that the patient refused absolutely to have any operations on his nose, thereby exposing himself to the necesity of having the same method adopted in case of a recurrence of the middle ear inflammation.

DISCUSSION.

Dr. F. B. Kellogg would like to see the curve of the catheter referred to.

Dr. W. D. Babcock said the same procedure was done at the Manhattan Eye and Ear Hospital some time ago.

Dr. W. H. Roberts said Kyle had an outfit for the same and he saw him use it.

Dr. A. L. Kelsey had catheterized through the opposite nostril.

Dr. H. A. Kiefer closed by acknowledging his indebtedness to Dr. Kyle for the idea he followed out.

XXVI.

DEMONSTRATION OF SEQUESTER OF THE TEMPORAL BONE OBTAINED DURING A MASTOID OPERATION.

By Henry L. Wagner, M. D.

SAN FRANCISCO, CAL.

The history of this case of traumatis mastoiditis is briefly as follows:

A perfectly healthy man, forty years of age, in falling from his wagon struck the back of his head upon the roadway. He bled from the nose, ear and mouth; unconscious for a few hours, intense swelling and pain, principally on the left side of head behind the ear, combined with fever. Patient under treatment by his family physician for some weeks. During this time spontaneous serous discharge from the middle ear, which later became purulent. Two months from time of accident patient came to my observation. He then had regular pulse, no fever, nor pain over mastoid region by pressure, only a very copious purulent discharge from the ear, indicating that the mastoid antrum was apparently the source. Microscopic analysis revealed streptococci. During the extensive mastoid operation, I found the periost very adherent to the bone, indicating a subsided periostitis. The larger part of the mastoid bone was removed from the zygomatic cells, including them, clear to the tip of this bone, disclosing a pneumatic structure and this sequester was found in its petrous portion. In removing the sequester both of its ends were broken off; it now measures two centimeter in length and one in width, and it was at least a centimeter longer before being broken. Whether this sequester had been formed by the process of streptococcic osteomyelitis, or by fracture, or by both, is difficult to say. The patient made a slow but uneventful recovery. Directly after the operation not the slightest trace of pus was observed to come from the middle ear.

XXVII.

A NEW TONSILLOTOME.

BY EDWIN PYNCHON, M. D.,

CHICAGO.

PROF. RHINO-LARYNGOLOGY AND OTOLOGY, CHICAGO EYE, EAR, NOSE AND THROAT COLLEGE.

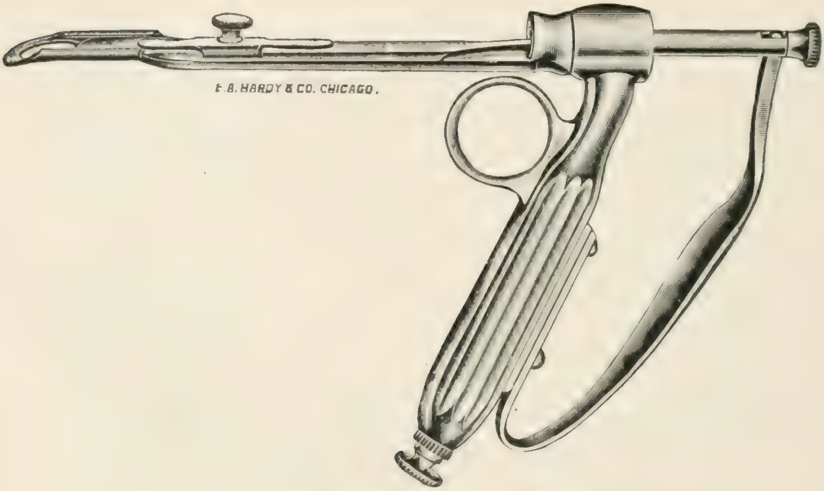
At the meeting of the American Academy of Ophthalmology and Oto-Laryngology, at Denver, Aug. 24-26, 1904, I exhibited a tonsillotome, the handle of which was a continuation of the shaft of the instrument and the blade of which was spring actuated so as to automatically remain back of the fenestra. It was illustrated and described in the Dec., 1904, issue of *The Laryngoscope*.

As a result of further experiment I have changed the instrument so the handle is at less than a right angle to the shaft of the blade. In this way more pressure can be applied in its use, than when placed at the usual angle which is, to an equal degree, more than a right angle. The ring through which the index finger is placed improves the grasp and also serves as an auxiliary handle when adjusting the mouth-gag etc. In order to retain the advantage of the spring actuated handle I have employed a spring quite like the spring of a grapevine shears. In this way it can be used equally well in either hand by one who is not ambidextrous, while in the position shown in cut, if desired, the blade can be revolved so its concavity will be in the opposite direction, by pulling down the button which is at the lower end of the handle, whereby the blade is unlocked, so it can be revolved at will, there being a stop notch on either side. This combination of spring and handle gives to the hand the maximum degree of cutting power.

I retain the form of blade, curved on the flat, which I have previously used in both a Mathieu and an Ermold tonsillotome, whereby the cut conforms to the normal curve of the faucial side walls. With this instrument a tenaculum forceps should be used to pull the tonsil well through the D-shaped fenestrum.

the proximal side of which is made without curve, so as to materially increase its area. The straight edge furthermore conforms to the line of the posterior edge of the anterior pillar, and is therefore better than if curved.

I have as yet had made only one size of this instrument, the fenestrum of which is 1x⅝ inch, which is too large for a small child though large enough for the largest tonsil which I care to remove with a tonsillotome. In all cases, before use, it is desirable to first sever any attachments which may exist between the tonsil and either pillar. If this is thoroughly done a very large tonsil can be easily pulled through the fenestrum.



By removing the nut at the spring contact end of blade shaft and unlocking the revolving lock, the entire cutting portion can be quickly removed from the handle for sterilization. This tonsillotome has been perfected for me by F. A. Hardy & Co.

Columbus Memorial Bldg.

XXVIII.

NASAL OBSTRUCTION A CAUSE OF DEAFNESS.

By D. H. Trowbridge, M. D.

FRESNO, CAL.

I have, for several years, been endeavoring to settle in my own mind, the real importance of nasal obstruction as a causative factor of middle ear catarrh, and after observing a great many cases of this character, I am fully convinced that the obstruction of the nares is responsible for a great deal more disease of the middle ear than it has been given credit for in the past.

In looking over several text books on the disease of the ear, I was unable, in some, to find any reference to the nares and their relation to the ears, and in others, very little space was devoted to the subject. In all, however, there was a liberal space allowance given to the pharyngeal vault and the influence of its disease and growths on the hearing; so that one would suppose that the anterior and middle nasal region had but little to do in influencing the proper functioning of the ears.

I think that you will all agree with me that in examining cases of deafness in general, we find in a very great percentage of them, a decided change in the nose from the normal. In a few cases of deafness we find an atrophic rhinitis, and in such cases we are apt to have an atrophic change in the middle ear as well. But in by far the majority of the cases of middle ear catarrh that have come under my observation, it has been my experience to find obstructive changes in the nostrils.

We are all perfectly familiar with the decided effect which adenoid vegetations in the pharyngeal vault have upon the hearing, especially in children and in young people. We are every day finding cases of this kind where the patient is almost entirely deaf, and after removing the adenoid growth thoroughly, we find in a few days that our patient has perfect hearing. Now, if the enlarged third tonsil can be the agency in producing such a decided influence on the middle ear, it seems only reasonable to suppose that an enlarged and tumified middle or lower turbinate, which is just as near the orifice of the Eustachian tube, and is of the same continuous mucous membrane, should produce just as decided an effect.

Again, we are all accustomed to have a patient suffering from an acute cold, with inflammation of the membranes lining the nasal cavities, come to us with decided reduction of hearing, which is entirely relieved as soon as the acute cold and congestion in the nose is cured.

Reasoning from the above, it seems to me that the only natural conclusion to draw is, that where we find a patient who is suffering from chronically obstructed nostrils, either by enlarged turbinates or deformed septum, he is in danger of a chronic effect on the middle ear, just as an acute obstruction will produce temporary deafness. I make it a rule to examine the nostrils, as well as the pharyngeal vault, in every case of deafness that comes to me. And during the past several years, I have commenced the treatment of a number of these cases of deafness by operating on the nostrils to obtain a thorough ventilation of the nostrils. Of course this was after ascertaining that there was no obstruction in the vault of the pharynx. If there was a septal spur, I removed it. If the obstruction was due to hypertrophied turbinates, either middle or lower, I did a turbinectomy and this on one or both sides, as the anatomy of the nostrils demanded, to procure a good, free and open nostril on both sides.

In many of these cases I have been gratified to find decided improvement in the hearing after from two to four weeks. In cases where the deafness had not been of too long standing, or too severe a degree, the hearing became normal; in others it improved to some extent, and in still others of a more deeply seated character, I obtained little or no improvement in the hearing. Many of these cases that had been brought to find relief, came on account of the tinnitus, which is often the first symptom of which the patient complains, even before he realizes that he is becoming deaf at all. In some of these cases the tinnitus had entirely disappeared, and in a considerable number it was relieved to a large extent. In addition, in nearly all cases, the patient feels the relief obtained by being made to have free nasal respiration.

The results mentioned above were obtained in these cases without any other treatment. Of course, I do not believe every case of deafness will be cured, or even helped, by the above method of treatment. Only in cases where the changes in the middle ear are not too far advanced, can we expect to obtain any benefit in the hearing. However, by the relief of the nasal obstruction, we can do much toward staying the progress of the disease, even if it is not very decidedly helped, and this is of no mean value to a patient who is becoming slowly but surely deaf.

It is a fact that is not entirely clear to me, that the deafness caused by an enlarged third tonsil is quickly cured by removing the cause, while middle ear changes, caused by other nasal obstructions of more permanent character, are more persistent and constant and much more likely to remain permanent. However, I have had such good results in many cases following the thorough removal of nasal obstructive process that I can not but feel certain that it is a very decided factor in the causation of deafness. Therefore, it seems to me it is most necessary as a prophylactic measure if for nothing else, that we make it a rule to point out to our patients the need of obtaining and maintaining free nasal respiration as a preventative of possible future deafness, even where it has not already caused middle ear changes.

A few words on my own method of operating on these cases may not be amiss. I have, in recent years, almost entirely discarded the electro cautery on account of its limited power to remove tissue, and also on account of the severe reaction which follows its use. In past years when I frequently made use of the cautery, I was many times chagrined to find in a few days that my patient had a suppurating ear, which I felt was entirely due to the reaction of the cautery. Since discarding it, I have never had that unpleasant result, except once, and that in a case where excessive hemorrhage required a secondary plugging of the nose for several days. Then again, the cautery will not remove any of the bony formation. Hence, if a bony spur or an enlarged turbinate is to be removed, it certainly is inadequate. My preference is for the trephine drill, operated by a motor which does not revolve too rapidly. With this I drill out nearly all of the bone, which I desire to remove, and the remaining soft tissue can easily be snipped off with a Pynchon's or Hartman's fenestrated nasal forceps.

My aim in these cases is to produce a large, free, open nostril, and if we stop short of this we are apt not to obtain results. My experience has been that if I err, it is in not removing enough structure and that when the nostril is healed, that I have a nostril that is smaller than I wanted, rather than too large. I never remember finding after operating that I had a nostril that was too roomy, but on the contrary many times where I thought I had removed enough tissue, when the membrane was entirely healed, I found I had removed too little. I think there should be from one-eighth to one-fourth-inch space between the outer wall and the septum.

I do not for a moment think that old chronic cases of middle ear catarrh can be cured, or very much relieved, by the above method. Where once the condition is long established, it is one of the most baffling of the diseases we are called upon to treat. To cure, or materially improve middle ear catarrh, it is necessary to begin our treatment before the changes in the middle ear are advanced beyond the first stage. I think in cases of nasal obstruction in which the middle ear disease has not been of too long standing that we can expect much from a thorough removal of the obstruction.

Do not understand me as advocating this treatment as being sufficient in itself. Of course I make use of the ordinary methods of treatment and only advocate this as preparatory, as it were, on certain select cases which apply to us for relief.

With your permission I will report just a few cases:

Case 1.—Mr. B. consulted me on account of deafness of left ear. Test: Hearing watch R.—72/72 L.—24/72. He also complained of some tinnitus, and as he was a cornet player he complained of a peculiar, unnatural resonance in the ear when making certain notes. I found decided nasal obstruction on both sides, but most decided in the left nostril. This was removed, and by the time the wound was healed, his hearing was almost normal, even before the right nostril was operated upon. He still retains improvement under occasional inflations.

Case 2.—Miss P., a teacher, was referred to me by Dr. Flemming on account of deafness of two or three years' standing. Both lower turbinates were prominent. I advised operation, and removed both lower turbinates at different sittings. Her tinnitus has disapeared, and although I have not seen her recently, her physician reports her much improved in hearing, and very much pleased.

Case 3.—Mrs. B., consulted me on account of a chronic middle ear catarrh of several years' standing. Her hearing was considerably reduced, being for the watch R.—43/72 L.—3/72. On account of the chronic condition and the length of time she had been suffering, I did not give her much encouragement. I explained her case to her, and told her we could only try, and promised her nothing. I operated on the left nostril, which was not as decidedly obstructed as many cases I have examined. After the nostril was entirely healed, with the aid of a few inflations, I found her hearing considerably improved for the voice, and for the watch she heard 60/72 in right and 15/72 in left. Being an improvement of 12/72 with right, and 15/72 with left. This was really better than I had expected in thise case, on account of the length of time she had been suffering.

I could report other cases of like character, so that I can but feel that in treating middle ear cases without giving due attention to the nostrils, we are neglecting a most important part of our treatment.

DISCUSSION.

Dr. E. W. Fleming, Los Angeles: As he understood the paper, Dr. Trowbridge advocated nasal treatment for deafness more as a preventative than as a cure. To this Dr. Fleming agreed. He did not believe that operations for well established middle ear conditions would be of much avail. If operation procedures are advocated in these cases, they should be urged because of rhinologic reasons. If nasal obstruction did not exist, operation was not indicated. In cases of recent ear deafness, ventilation of the tube and ear could be improved by clearing nose of obstructions, but as a routine measure for well marked chronic catarrhal inflammation of the middle ear, he had not had much success by such procedure. Where there was posterior hypertrophy of the middle turbinate, then removal of posterior hypertrophy led quite frequently to improvement, so far as head noises were concerned.

Dr. C. F. Welty, San Francisco: To get at the bottom of this problem of obstruction, it was necessary to determine, first, what was to be done, and second, how was it to be done. Deafness could be classified as of three kinds, and two of these forms, viz., labyrinthine affections and oto-sclerosis, would give no response to nasal treatment. Where, however, an adhesion or catarrhal process with organized exudate binding down the small bones was found, there a response, and an immediate one at that (forty-eight hours) might be expected to show itself. A contributing cause to deafness, be it an hypertrophy or a deformed septum was always to be removed. Prefers scissors and knives to cautery in this class of operations.

Dr. R. W. Miller, Los Angeles, took it that Trowbridge's cases mere mostly children, afflicted with catarrhal deafness. Dr. Miller believed in conservatism in nasal operative surgery, for too often too great a removal of tissue leads to subsequent atrophy and loss of function of nasal tissue. A good rule would be never to destroy so much of the turbinates, that in acute rhinitis there would be an absence of contact and pressure.

Dr. D. H. Trowbridge, San Franciso: In closing the discussion, stated that it might be unwise to remove too much nasal tissue, but he had never seen a patient where such had been the case. As a rule, too little is removed.

XXIX.

THE MORPHOLOGY AND EMBRYOLOGY OF THE NASAL FOSSAE OF VERTEBRATES.

By LEON DIEULAFE,

Translated by HANAU W. LOEB.

(Continued from the March Annals.)

Mammals.

In all the series of mammals, the general plan of the structure of the nasal apparatus is almost the same, the variations being in the dimensions of the nasal cavity, the disposition of its orifices and turbinals and the amplitude of the sinuses.

NASAL CAVITY.—The usual shape of the nasal cavity is that of a quadrangular pyramid, with a base posterior and apex anterior. The turbinals modify the shape of the walls and lessen the lumen. The length of the cavity is generally proportionate to the length of the head and particularly to the length of the snout. The influence of the alimentary regimen is a large factor in these variations, while the height and size are dependent upon the extension of the respiratory apparatus.

EXTERNAL ORIFICE.—The anterior or external orifice is surrounded by a system of cartilages covered by skin, which forms the naris; to this, muscles are often attached. The musculature is often well developed and Wiedersheim (1890) reports the existence of sphincters and special valves in diving mammals. The orifices are often situated behind the end of the snout (Quadrumana), just at the end of the snout itself (Carnivora, Rodentia, etc.); sometimes they are prolonged into a tube, in which case a cartilaginous canal lies anterior to the nasal bones and articulates with them. This is the case in animals with projecting snouts (bears, moles). The snout of the pig is a rigid tube surrounded by circular fibres. Sometimes the nasal orifices end in a single tube of long dimensions, as the trunk of an elephant. The orifices may lie on the dorsal surfaces of the head (the blow holes of the cetaceans). The cartilaginous skeleton which surrounds them may be incomplete, as in the nose of the solipeds and ruminants. Finally the external orifice may have rigid borders, as in Ornithorhynchus, in which it perforates the superior surface of the horny box which supports the maxillary.

BLOW HOLE OF THE CETACEANS.—There are certain whales which, on account of the single blow hole, are considered as monorrhinal. In reality, the blow hole leads into a chamber (spiracular cavity) in which the two nares end. Some valves (valves of v. Baer) separate the spiracular cavity from the nares. These cavities send diverticula in various directions (spiracular sacs and nasal sacs). The nares are provided with dilator muscles, retractors of the nasal alae and constrictors of the nose. In the sperm whale the nasal region is specially affected by the asymmetry of the cranium. The blow hole is to the side of the median line. The left naris has normal dimensions, the right is large, but it ends in a true nasal cavity (Pouchet and Beauregard, 1885). According to Pouchet (1889), the symmetrical position of the blow hole of cetodonts may be explained on the supposition that the latter is formed by the naris of the corresponding side (left in the sperm whale) into which, by special embryogenetic process, the nasal cavity of the opposite side opens. He noted in an embryo of the sperm whale, that the right naris was obliterated by epithelium, and the communication between the two cavities effected through the agency of the epithelial expansions, originating from the nares themselves and giving origin in a general way to the sacs of the blow hole.

Kükenthal found the nares fused together, forming a vestibule, in embryos of the dolphin.

Abel (1902) attributed to the position of the nasal fossa the cause of the cranial asymmetry in the odontocetes, but according to this author, this does not depend upon a superficial asymmetry, because the external nares, which are found in the skin, remain in the median line in the animals which he has studied. The deformity is in the bony system. The asymmetry of the cranium is greater in the varieties where the nares are placed higher up (Platanistidae, Ziphiinae); on the contrary, when the nares are placed more anteriorly, the bilateral symmetry hardly deviates (Zeuglodon, Phocaena, Neomeris, Cyrtodelphis); on the other hand, in young animals in which the nares are found much in advance of the cranium, the asymmetry is very slight or nil. The recession of the nares allows the animal to breathe when only a small portion of the head is outside of the water. The principal bony modifications are in the nasal and interparietal bones, which become rudimentary.

CHOANAE.—The posterior orifices or choanae end in the pharynx behind the soft palate. The air which goes through the nasal cavity passes through the pharynx before reaching the larynx. In certain cases the air enters directly into the larynx, when it occupies a very high position and ascends just behind the soft palate (solipeds). The opening of the choanae is placed sometimes in a vertical plane (monotremes, marsupials, proboscidians and primates), and sometimes in an oblique plane (carnivora, ruminants, solipedes). The two pterygoid processes limit a sort of fossa, very variable in its extent, into which the two choanae open.

NASO-PALATINE CANAL.—We find not only an incomplete palatal vault, as in birds, but also a communication persisting between the nasal and the buccal cavities in their anterior region. This is the canal of Stenson, incisor foramen or naso-palatine canal. It was discovered by Stenson and described by Bartholin, Verheyen and Santorini. It is not patent in all mammals. Lieutaud, Bertin, Heister, Holler, Portal, Boyer and Scarpa claim that it is impossible to enter the mouth from the nasal cavity through this canal, especially in man, in whom it is most atrophied. Jacobson and Cuvier are in accord with this opinion. According to Rosenthal, Weber, Huschke and Arnold, it is normally perforated. Leboucq (1881) has observed in several human fetuses (4th and 5th month), that the canal was precociously obliterated by the accumulation of an epithelial mass. The palatal papilla, which Merkel considers as a sensory organ, is placed between these two orifices or their remains in man.

SKELETON.—The internal wall is a septum formed by the vomer, a cartilaginous lamina and the vertical plate of the ethmoid. The inferior wall, slightly concave transversely, is composed of the palatal laminae of the superior maxillary and of the palate and a process of the intermaxillary. The roof or superior wall is formed by the nasal, the nasal spine of the frontal, the cribriform lamina of the ethmoid and the body of the sphenoid. The intermaxillary, the superior maxillary, the lachrymal, the lateral mass of the ethmoid and the vertical lamina of the palate constitute the external wall.

The osteology has been studied, with much detail, in the works on human anatomy, comparative osteology and monographs on certain mammals (dog, cat and rabbit), so that we need not give, as in the preceding groups, a special description of each bone of the nasal framework. We will give details only of the arrangement of the bones. In the monotremes (Ornithorhynchus and Echidna) it is difficult to distinguish the sutures between the different bones of the cranium and the face. The facial wall is elongated, and in the Ornithorhynchus the superior maxillaries support a horny box.

The marsupials have nasal bones which are larger behind than in front, of which the anterior border is free and the external border articulates with the intermaxillary. The superior maxillary is very long and the posterior third of its inferior border is provided with tooth sockets. The palatal laminae of the palate bones are very extensive.

The cetaceans have bones which are very great in volume, the maxillary and intermaxillary being very large longitudinally. They have been studied by Abel (1902) in the Eurhinodelphis (dolphins of the upper Miocene). These animals possess a double orifice (foramen olfactorium) for the passage of the olfactory nerve, while the nerves no longer exist in the true delphinides.

In Edentata (ant-eater), the bones of the face have an excessive length, constituting a true cylindrical beak, which is flattened on its inferior surface. The nasal fossae have the form of funnels; the nasal bones, which are very long, are narrowed towards their posterior part so as to pass between the anterior spine of the frontal and the superior maxillary, their anterior extremities reaching that of the superior maxillary. The palatal lamina of the palate bones are very large. The pterygoids aid, posteriorly, in forming the nasal floor. Anteriorly, the nasal cavities are separated by the vomer; posteriorly they communicate extensively with one another.

The nasal bones of the Insectivora (hedgehog) are only narrow bony bands, hardly perceptible. On the other hand, the intermaxillary are very well developed in size and form a part of the nasal roof. The nasal bone articulates with the internal border of the intermaxillary throughout the whole of its anterior extremity. The palate bones are joined with the superior maxillaries without distinct limits. The pachyderms have massive bones. In the tapir, the intermaxillaries are joined together in the median line; posteriorly they do not reach the nasal bone. The internal or superior border of the maxillary ascends posteriorly and articulates with the descending process of the nasal. The intermaxillaries take only a very restricted part in the formation of the palatal vault. The nasal bone, large posteriorly, becomes thin anteriorly; the process which articulates with the maxillary passes from the posterior part of the external border. It is directed downward, then forward, forming a sort of prop which supports the nasal roof.

Among the probiscidians, the hippopotamus has very long nasal fossae, in conformity with the head. The anterior orifices are bordered by the lateral masses appertaining to the intermaxillary, which are not distinctly separated from the maxillaries in these animals. The nasal bones have a quadrilateral form; posteriorly it is difficult to distingush them from the frontal.

In the elephant the intermaxillary is very large and very long. Its body is well developed and carries the anterior nasal orifice towards the middle of the face. The two anterior nasal orifices end in a large excavation which overhangs a median pyramidal ridge belonging to the nasal bones, which fuse completely with the frontal. At the bottom of this antrum, the vomer separates the two nasal fossae. The external wall is formed only by a thin bony lamella, external to which a large hollow cavity is found in the superior maxillary. Towards the middle portion of the cavity, the external surface is convex and the lumen narrowed. The floor of the nasal fossae is very narrow compared to the dimensions of the head.

In the solipedes (horse and ass) the intermaxillary does not reach the frontal. It reaches the external border of the nasal bone at the union of the anterior with the middle third.

The intermaxillary of the ruminants stops at the superior border of the maxillary without reaching the nasal junction, in which case it has the same disposition as in that of the solipedes.

Among the rodents the guinea-pig has very large nasal bones, which are in contact with the intermaxillaries throughout their external border. They lie between the nasal and the superior maxillary as far as the frontal.

In the bear (Carnivora) the nasal bones are long, and the intermaxillary passes backward to the frontal. The primates resemble man so much that there is little difference from an osteologic point of view. The intermaxillaries are very distinct, as in other mammals, while in man they are completely fused with the superior maxillary. The nasal bones of the monkey are solidly united to one another and almost fused.

In man the internal wall or nasal septum, formed by the vomer, the perpendicular lamina of the ethmoid and the cartilage of the septum, does not always divide the nasal fossae into two equal cavities. It is often asymmetrical and inclined to the right or left. The septum is always symmetrical in the first years of life. In the adult, on the contrary, it is asymmetrical in more than half the cases. Cloquet expresses the opinion that the curvature depends upon a primitive law of organization. This deviation seems to us to be due to the asymmetry of the face, which may be considered normal and which is found in the most beautiful faces. Exaggerated, annoying deviations may be produced by inflammation of the mucosa, under the influence of which the physiologic curve of the subjacent cartilage is accentuated.

Lumen of the Nasal Cavity.—Ridges encumber, modify and complicate its form in various ways. These ridges, the turbinals, are inserted, on the external wall, and on the ethmoid. Between their bases of insertion are spaces in the form of fossae, known as the meatuses. Between the free border of the turbinals and the septum the lumen is more or less narrow, forming an irregular canal, dilated in its middle part and narrowed at its extremity. In viewing a transverse section of the nasal fossae, made at the region of their greatest vertical height (Fig. 20), one becomes immediately impressed with the reciprocal relations which exist between the respiratory and olfactory portions. The superior part of the lateral wall, in man, is so close to the nasal septum that there is only a narrow cleft between them. The mucosa which covers this region has a structure and appearance different from that covering other points of the cavity, and we shall study this under the name of the olfactory mucosa. The subjacent respiratory passageway, enlarged at the level of the meatuses and narrowed at the level of the turbinals, is separated, in man, according to Meyer (1885), from the olfactory cleft by the free border of the middle turbinal, which corresponds to a slight swelling of the nasal septum.

Nasal catarrh may easily cause an almost complete obliteration of this narrow hiatus, and one may therefore understand how this affection may occasion frequent interference with the perception of odors.

The nasal fossae of quadrupeds are not separated into two but into three cavities, because of the tremendous development and horizontal position of the terminal lamina of the ethmoid. They are the anterior, which encloses the inferior turbinal, the posterior, situated between the floor of the nose and the terminal plate (nasopharyngeal canal of Dursy), and the superior, placed above the preceding and containing the olfactory margins (Zuckerkandl).

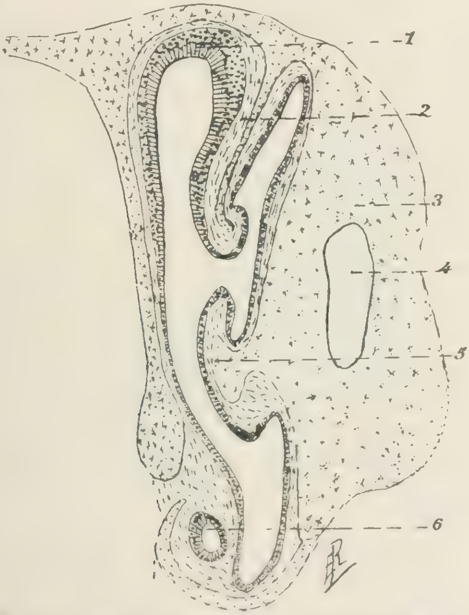


Fig. 20—X 34.3. Mouse (transverse section of the nasal cavity comprising the organ of Jacobson and showing the olfactory and respiratory regions). 1. Olfactory epithelium; 2. Ethmo-turbinal; 3. Superior maxillary; 4. Maxillary sinus; 5. Maxillo-turbinal; 6. Organ of Jacobson.

Into the meatuses open the accessory cavities, true expansions of the nasal mucosa into the facial bones. In certain cases, in which one of these cavities, the frontal sinus or the maxillary sinus, is found open by some accident, it may be shown that the mucosa which covers it transmits no olfactory impression. These sinuses, therefore, should occupy a special relation to the respiratory passageway. With the exception of the sphenoidal sinus and the posterior ethmoidal cells which open into the olfactory region (superior meatus and olfactory or ethmoidal fossa), all the other cavities, especially the most important (frontal sinus, maxillary sinus and anterior ethmoidal cells), open into the middle meatus below the middle turbinal.

Before undertaking the study of the nasal mucosa we shall study the ridges and the anfractuosities which they cover: 1, turbinals; 2, sinuses.

Turbinal Apparatus.—We may distinguish three turbinals in man: inferior, middle and superior. This division cannot be equally applied to all mammals. It is therefore preferable to differentiate the turbinals after the terminology of Schwalbe, Zuckerkandl, Seydel and Killian, into maxillo-turbinal[1], naso-turbinal and ethmo-turbinals.

The baso-turbinal of Schönemann is classed with the ethmo-turbinals.

Maxillo-turbinal (Inferior turbinal, concha maxillaris). —This is a ridge, elongated antero-posteriorly, inserted upon the nasal surface of the superior maxillary. The lamina of insertion is directed towards the interior of the nasal cavity, and there it rolls up or branches, its form often becoming very complicated. Harwood distinguished two principal forms: twisted turbinals (Herbivora) and branching turbinals (Carnivora). Zuckerkandl (1887) divides the various forms of inferior turbinals of mammals into two types: coiled turbinals and branched turbinals. The coiled turbinals may present a one or two coiled laminae; in the latter case there is a superior and an inferior. The coiled turbinal always leaves a certain space between its free surface and the septum; the branched turbinal may completely obstruct the nasal lumen.

The monotremes studied by Zuckerkandl (Echidna and Ornithorynchus) present differences in the disposition of the inferior turbinals. In Echidna aculeata typica, the inferior turbinal is an elongated projection which has two grooves upon its free surface; there is hardly a trace of rolling.

In an Echidna of undetermined species, two lamellae extended from the lamella of origin, one directed downwards and one directed upwards. The grooves placed upon the free

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(1) Turbinal comes from turbo, turbinis, meaning rotation.

border of these lamellae are doubled by secondary lamellae, which is the beginning of a ramification. In Ornithorhynchus paradoxus, the surface of the turbinal is divided into 17 lamellae; here the secondary lamellae are branched into tertiary lamellae and these latter are rolled up at their extremities.

According to Allen and Otto Grosser (1902), the Cheiroptera of the Insectivora have an inferior turbinal in the form of a long band. We have studied the badger, which has a very well-developed inferior turbinal. Its pedicle is long and thin. Upon its middle portion, and upon an extent equivalent to one-half of its length, it supports a large round mass, convex upon its superior, inferior and external surfaces, flattened upon its internal surfaces and cut into a very large number of lamellae extending antero-posteriorly.

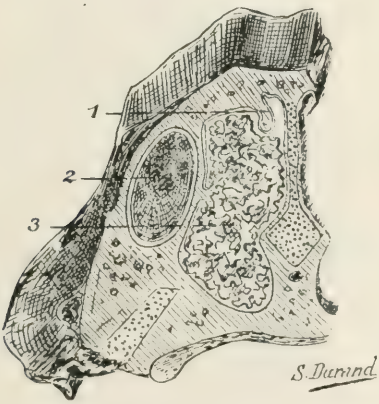

Fig. 21. Twice natural size. Badger (transverse section, showing spongy network formed by the ramifications of the maxillo-turbinal). 1. Naso-turbinal; 2. Maxillary sinus; 3. Maxillo-turbinal.

We have here a beautiful type of branched turbinal. In a very interesting transverse section (Fig. 21) we may see that it fills up the nasal cavity, which is very spacious. The lamellae, which are irregularly branched a great number of times, include between them some spaces, areolar in appearance, which give to the inferior turbinal a sponge-like aspect. The respiratory air is absolutely obliged to pass through this meshwork. Similarly the inferior turbinal in the elephant is cut up into numerous vertical lamellae.

In the ruminants there are two coiled laminae, as in the pachyderms. In the sheep the antero-posterior extent of the turbinals is very large. The middle region forms a strong prominence which is flattened laterally, very high, and is composed of two parts, one situated above, the other below the lamina of origin. In the transverse section (Fig. 22) it may be easily seen that each of these parts is a coiled lamina, the upper one describing about a turn and a half, the inferior one complete turn. The solipeds (horse and ass) have a very voluminous inferior turbinal, but it has only a single coil.

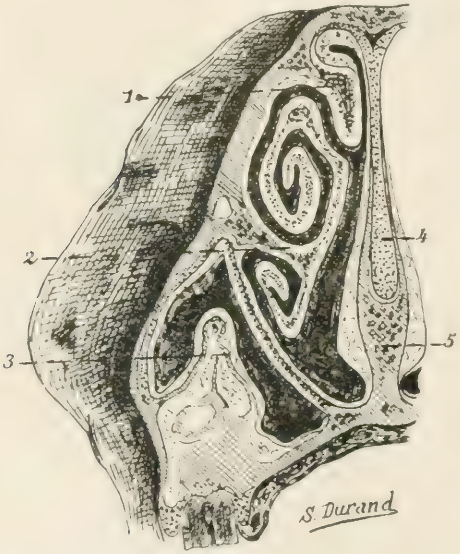

Fig. 22. Six-sevenths natural size. Sheep (transverse section showing double rolling of the maxillary turbinal). 1. Naso-turbinal; 2. Maxillo-turbinal; 3. Maxillary sinus; 4. Cartilaginous septum; 5. Vomer.

In the rodents (rat and guinea pig) the anterior extremity of the turbinal reaches the level of the nares. There is only one roll, directed upwards.

The inferior turbinal is very complicated in the Carnivora (seal, otter, beaver), according to Cuvier. It is cut up into multiple lamellae in the dog; in the cat the turbinal is extended obliquely backward and downward. Its middle portion is voluminous and almost cylindrical, and is cut up into lamellae by antero-posterior grooves.

The same disposition is found in the tiger. In a large number of monkeys, the inferior turbinal is a ridge more or less prominent, rounded vertically, voluminous in its middle part (Cercopithicus). In the gibbons and cebus there are two rolls. In man it is a thin, curved lamina, slightly rolled, having a body and three processes (Henle). The anterior or lachrymal process serves to limit the osseous lachrymal canal; another, the posterior or the processus ethmoidalis, is articulated in several places with the uncinate process of the ethmoid; the third, or processus unciformis, is directed downward opposite to the two others. (See Zuckerkandl, *Anat. Foss. Nasal.* Pl. IV., Fig. 2.)

NASO-TURBINAL (Middle turbinal of certain mammals, anterior turbinal of Schwalbe, agger nasi of man, first ethmoturbinal of the writers).—This turbinal is placed above the maxillo-turbinal, inserted upon the external portion, partly in the ethmoid region and partly in that of the superior maxillary. Zuckerkandl (1895) describes in it a free portion in the cavity (pars libera), and a posterior portion covering the ethmoidal turbinals (pars tecta).

In certain mammals (rodents) its situation places a middle turbinal between the maxillo-turbinals and the ethmo-turbinals (Fig. 23); in others (carnivora and ruminants) it lies throughout its extent above these different turbinals. Schwalbe, Seydel and Killian consider it the first ethmo-turbinal; Peter (1902) separates it from this group. His classification, based upon their origin, separates them from one another, and distinguishes those which arise from the external nasal wall (maxillo-turbinal and naso-turbinal) from those which arise from the internal wall (ethmo-turbinal).

The naso-turbinal, being a turbinal quite distinct in its anatomic relations, is reserved for a special description.

In the guinea-pig (Fig. 23), it is a lamina placed above the inferior turbinal, the superior border of which it covers, extending from the anterior extremity of this turbinal to the anterior extremity of the ethmoidal turbinals. Its lamina is simple, without rolling.

In the rat it is inserted upon the most elevated portion of the external wall, and is folded inferiorly; it begins a little behind the anterior extremity of the inferior turbinal and terminates at the same level as the latter. Its posterior border is notched by the anterior extremity of the superior ethmoidal turbinal.

In the cat the naso-turbinal presents another appearance; it is inserted along the entire nasal roof; it runs along it, and does not descend towards the inferior turbinal to form a ridge between it and the ethmoidal turbinals. Its anterior extremity is situated between the nasal roof and the inferior turbinal. Schönemann represents it thus in the embryos of the cat, calf and rabbit. In this disposition it is not a middle turbinal, but an anterior, or, better, an antero-superior turbinal. It is the ethmo-turbinal I.

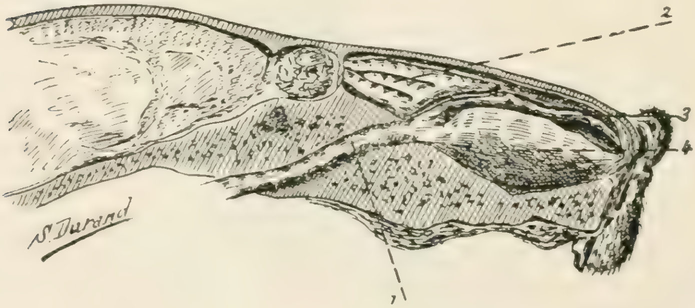

Fig. 23. Twice natural size. Guinea-pig (Sagittal section, passing external to the median line, showing the external nasal wall. 1. Naso-pharyngeal canal; 2. Ethmo-turbinal; 3. Naso-turbinal; 4. Maxillo-turbinal.

In the sheep and badger, the naso-turbinal is a simple, slightly projecting margin, placed along the nasal roof. It is represented in man, but it does not correspond to the middle turbinal.

Schwalbe (1887) has shown that the ridge which v. Meyer called the agger nasi is a vestige of it; Zuckerkandl describes the agger nasi as the pars libera, and the uncinate process as the pars tecta of the naso-turbinal of man. The agger nasi is a ridge placed upon the frontal process of the superior maxillary, joined to the middle turbinal (Zuckerkandl, Pl. IX., Fig. 4; Schwalbe, *Anat. der Sinnesorgane*, 1887, Fig. 27). Schwalbe considers it the rudiment of the anterior turbinal.

So the naso-turbinal is, in certain cases, a middle turbinal, intermediate to the maxillo-turbinals and ethmo-turbinals (guinea-pig, rat); in other cases it is an anterior turbinal (cat, rabbit), and in others (monkey, man) it is reduced to a simple ridge.

ETHMO-TURBINAL (olfactory turbinals or projections, baso-turbinal of Schönemann, conchae obtectae, ethmoidal volutes, middle and superior turbinals of man).—The number of olfactory turbinals varies in mammals from three to nine, the number five being most common (carnivora, rodents, insectivora, lower monkeys). Zuckerkandl distinguishes the lateral olfactory projections from those which freely arise from the median wall. Seydel names them principal and accessory turbinals. They all have a simple lamina of origin from the ethmoid (Schwalbe). Karl Peter (1902, 1) distinguishes them from the lateral turbinals (maxillo-turbinal and naso-turbinal) by the generic name of medial turbinals. Schwalbe (1883), Seydel (1891), Killian and Zuckerkandl consider the naso-turbinal as an ethmoidal turbinal, regarding the olfactory projection as more important than Peter does.

The ethmo-turbinals are characterized as ridges inserted upon the anterior surface of the ethmoid, and are free in the nasal cavity. Together, they form a triangular mass with attached base (baso-turbinal). This ridge may be cut by grooves of the external surface into the form of projections, or completely subdivided into distinct lamellae. The different turbinals are generally parallel to one another, their volume is not uniform and their length diminishes from above downwards.

Among the monotremes, Ornithorhyncus, according to Simon Paulli (1900), has a very much reduced ethmoid, while in Echidna it is well developed and very complicated.

In the marsupials, the carnivora are recalled (Chatin). According to Simon Paulli, it is divided into five turbinals, a number typical in mammals (including naso-turbinal). In Cheiropteres vespertilionides, Otto Grosser describes two series of ethmoidal turbinals. A rudimentary naso-turbinal exists in the median series. The second is the largest, the third and fourth the smallest. They are very simple, being thick lamina in the form of a club on their free border.

The badger has a large middle ethmoidal turbinal with a pointed ending anteriorly. Superiorly and inferiorly it ends in a series of fine lamellae disposed antero-posteriorly.

The sheep is provided with a large turbinal inserted by its base upon the median portion of the ethmoid in the form of a triangular pyramid with apex anterior. Its inferior surface is applied against the posterior border of the maxillo-turbinal, its superior surface answers to the other ethmoidal turbinals. Internally it has a plane surface, externally a round border. It may be described as a middle turbinal on account of its situation.

Above and behind this turbinal, the ethmoid supports four others, which are almost cylindrical projections separated from one another by deep longitudinal grooves; they are free on their anterior extremities. There are four turbinals in the goat. According to Simon Paulli, the fissure formation is at a minimum in the ruminants, but in the other ungulates the number may reach eight (horse). It is the same in the rhinoceros, tapir, pig and the peccary.

Among the rodents the guinea-pig has three ethmoidal turbinals (Fig. 23); they are not completely separated from one another, the superior and middle being united at their anterior extremity; the inferior has a free anterior extremity. They form together a triangular ridge inserted by its base upon the anterior surface of the ethmoid, being free on all other sides.

The rat has four ethmoidal turbinals; the superior is longest and reaches greatly beyond the second, which reaches beyond the third. The first three turbinals are curved and directed downward at the level of their anterior extremity. The fourth or inferior turbinal has a free pointed anterior extremity.

The cat has a well-developed collection of ethmo-turbinals. We may distinguish a superior turbinal, parallel to the roof of the nose; a second turbinal, parallel to the preceding and applied along its inferior surface, united anteriorly to two laminae extending downwards and backwards. Between these laminae and the anterior portion of the ethmoid, a triangular ridge is interposed which is flattened transversely and placed between the ethmoidal lamellae and the septum. In all there are three turbinals, one of which is divided into two. According to Simon Paulli, bears have seven olfactory projections and the Mustelidae six to seven. In Pinnipedia the number is five to six.

In the prosimians (Lemur cotta) Seydel describes four olfactory projections, besides the naso-turbinal. They arise from three basal lamellae, the first of which has two rolls. There are three principal and two accessory turbinals, of which the superior limits the frontal sinus below, while the other lies between the first and second principal turbinals.

In the lower monkeys the number of ethmoidal turbinals, according to Zuckerkandl, varies from one to three; the mycetes have only a single turbinal.

The anthropoid apes exhibit a striking resemblance to man in respect to the ethmoidal turbinals. These turbinals are no longer inserted by distinct pedicles. The nasal surface of the ethmoid labyrinth presents, as in man, a furrow, which determines the formation of two or three turbinals, ending in a point posteriorly. Zuckerkandl found in Hylobates concolor three turbinals on the left and two on the right side; in the orang one and rarely two; in the chimpanzee three in one instance and four in another; in the gorilla sometimes three and sometimes two.

In man, Zuckerkandl (1895) finds, on the median wall of the ethmoid labyrinth, two or three clefts dividing the osseous lamina into three segments, and exceptionally into four. Three typical ethmoid turbinals are designated under the name of inferior, middle and superior. The inferior ethmoidal turbinal resembles the maxillo-turbinal; the posterior extremity terminates in a point beyond the labyrinth; the anterior extremity, which is truncated vertically, is shorter by one to two centimeters than that of the maxillo-turbinal, and it is continuous with the agger nasi. The anterior extremity of this turbinal may be transformed into a large vesicle (concha bullosa). The middle ethmoidal turbinal is placed above the inferior and is shorter by 7 to 15 mm.; its form and extent are very variable and it is sometimes rudimentary.

The superior ethmoidal turbinal, irregularly quadrangular, is placed between the superior ethmoid cleft, the cribriform plate and the anterior wall of the sphenoid sinus. It may be transformed into a vesicle or in other cases it may have a spherical ridge limited in one place.

The fourth or supreme ethmoidal turbinal is found by Zuckerkandl in 6.7 per cent of the cases. When it is well developed it has the form of the middle ethmoidal turbinal, but it is sometimes reduced to a simple ridge.

Behind the uncinate process, which, with the agger nasi, represents the naso-turbinal, is found constantly, says Zuckerkandl, an osseous, hollow, round projection, which forms part of the ethmoid labyrinth. Its convexity is towards the middle meatus and it is covered by the inferior ethmoidal turbinal. This is the bulla ethmoidalis. This projection corresponds to an atrophied olfactory projection.

RESUME.—The maxillo-turbinal, the most inferior and anterior of the turbinals, exhibits only two types in the series of mammals: rolled or branched.

The branched turbinal presents every degree from the simple turbinal crossed by longitudinal grooves, as in the Echidna, to the branched turbinals of the third degree, disposed in every direction, as in the badger. The rolled turbinal may present a single lamellar coil (solipeds, rodents, man) or two laminae, one above and one below the lamina of insertion (pachyderms, ruminants).

The naso-turbinal placed above the maxillo-turbinal may be parallel to it and may insinuate itself between its posterior extremity and the ethmo-turbinals (guinea-pig, rat), or it may be parallel to the roof of the nose and pass backward above the ethmo-turbinals (ruminants, carnivora). It is reduced to a simple ridge (agger nasi), anterior to the middle turbinal, in man.

The ethmo-turbinals, varying in number from three to five, are inserted in the posterior part of the nasal cavity, upon the body of the ethmoid. Their form is that of a triangle with a base posterior. They are sometimes united together (guinea-pig), sometimes completely separated from one another (badger). At other times one of the turbinals may be very voluminous and entirely detached from the others, which are united together (sheep). The typical number is five, as found in the marsupials. In man the ethmoidal turbinals are represented by the middle and superior and accessory turbinals and by vestiges such as the bulla ethmoidalis.

The presence of turbinals greatly augments the surface of the olfactory and respiratory regions. This augmentation is:

In the sheep, 4.9 times for the olfactory and 1.52 times for the respiratory surface;

In the dog, 2.46 times for the olfactory and 1.48 times for the respiratory;

In man, 1.30 times for the olfactory and 1.39 times for the respiratory.

ACCESSORY CAVITIES OR NASAL SINUSES.—These are the hollow cavities of the bones of the face and head in the neighborhood of the nasal fossae, with which they communicate. They are covered by a mucous membrane continuous with that of the nasal apparatus.

We have already stated that, as a general rule, their orifices open into the respiratory region with the exception of the sphenoidal and some ethmoid cells which open into the olfactory region.

The older writers who make mention of the sinuses appeared to be greatly interested in the nature of their contents. A large number insisted on the presence of a green membrane, membrana viridis; e. g., Laurentius (1628), Spigel (1645), Bauhinus, Olhafius, De Marchettis (1654).

Schneider claimed that this was a cadaveric phenomenon. Others held that these spaces had medullary contents. The following may be cited as holding this opinion: Albertus Salomon (1583), Bartholinus (1658), Jessen (1601), Kyper (1660), Veslingius (1637), (Palfyn (1712), Vesalius (1725) Fallopius (1562) and Diemerbroeck (1685) held that the frontal sinus and the other accessory cavities were alternately filled and empty.

Fallopius claimed that only air and mucus were present.

According to Valverda, Columbus, Riolan (1618), Vereheyn and Schneider, the sinuses contained air.

Highmore (1681) advanced the idea of the pneumatisation of the sinuses. Riolan (1649) was the first to make a study of the cavities together.

Vieussens and Haller thought that the sinuses had the function of secreting mucus.

After the latter, anatomists were divided into two camps: Those holding his view, Arnold, Bidder, Haarwood, Huschke, Hyrtl, Magendie, Rudolphi and Walter; others holding that the sinuses and cavities were pneumatic, Braune, Clasen, Langer, Meyer and Weber.

Zuckerkandl remarks that we have not gone beyond the accurate observations of Columbus, Fallopius, Riolan and Schneider.

The volume of the sinuses varies greatly in the different species of mammals. While Richerand states that the sinuses are tremendously developed in all animals which excel in the acuity of olfaction, Müller claims, on the contrary, that the principle which presides over the formation and modification of the organ of olfaction is the multiplication of the olfactory surfaces in a small space.

Braune and Clasen (1877) have measured the volume of the nasal cavities and the various sinuses in man. The average figures corresponding to them are as follows:

Right frontal cavity......	3.1 cc.	left,	3.4 cc.
Right sphenoidal	4.0 cc.	left,	1.8 cc.
Right ethmoidal	3.1 cc.	left,	4.5 cc.
Right maxillary	12.5 cc.	left,	11.6 cc.

The total volume of the two sides was 44 cc., of the two nasal cavities 30.5 cc. The ratio was 144 to 100.

Zuckerkandl and Seydel, without according to the sinuses a role in the phenomenon of olfaction, claim, especially as to the frontal and sphenoidal, that these cavities include portions of the powerful ethmoid labyrinth in animals with great olfactory power.

In microsmatic animals and in man, the nasal cavity is sufficient to contain the reduced ethmoid, and the sinuses, thenceforth free, disappear or remain as empty cavities.

Simon Paulli does not accept this view, which is erroneous, for Zuckerkandl has confounded portions of the nasal cavity with the pneumatic spaces.

According to Simon Paulli, pneumatisation of the cranium is missing in monotremes and marsupials.

The kangaroos, however, according to Cuvier, have a frontal sinus.

SINUS MAXILLARIS.—The maxillary sinuses, according to Cuvier, are smaller in the Quadrumana than in man. They are reduced almost to nothing in the carnivora, the rodents and the edentates. In most of the other unguiculates they exist, but are a part of the nasal cavity, from which they are not separated by a narrow opening. The pachyderms have no sinus maxillaris, but they have a malar sinus.

In the insectivora the maxillary sinuses are the only pneumatic cavities. They are very large in the ruminants, and open into the nose by an oblique and narrow cleft situated behind the inferior turbinals. Those of the sheep are long antero-posteriorly; upon transverse section they have an elliptical form, but their inferior wall makes a large ridge in the cavity because of the dental alveoli. They are relatively very large.

The maxillary sinus of the horse is divided into two compartments by the supermaxillo-dental canal which traverses it. The internal compartment communicates with the sphenoidal and ethmoidal sinuses, its wall making a ridge in the interior of the nose.

In the elephant the sinus maxillaris is immense, separated from the nasal cavity by a very thin, bony wall. It is partitioned into a multitude of very large cells.

In the carnivora the ethmoid labyrinth, according to Zuckerkandl, forms a projection into the sinus and narrows it. We have not seen a sinus maxillaris in the cat.

In the monkeys the sinus maxillaris is very spacious. In the orang it forms, with the hollow space which replaces the ethmoid cells, a large single cavity, which leads into the sphenoidal sinus.

In man this is the largest of the accessory cavities. It is external to the lateral walls of the nasal cavity and below the floor of the orbit. Its form is that of a triangular pyramid with a base superior, or to the orbital side. It opens into the nasal cavity by two orifices, a principal (ostium maxillare) joining with the frontal opening in the region of the infundibulum, in the middle meatus, lying behind the bulla ethmoidalis. This will be discussed in connection with the frontal sinus. The other accessory orifice (ostium maxillare accessorium) is inconstant, occurring once in ten times. It was discovered by Giraldés; it is situated in the posterior part of the middle meatus (Zuckerkandl, 1895).

FRONTAL SINUS.—The frontal sinuses are lacking in a large number of animals. Among the ruminants, the deer is unprovided with them. In cattle, sheep and the goat they are very extensive. The sheep's frontal sinuses are very large cavities, occupying almost the whole extent of the frontal bone, provided at their antero-internal angle with an orifice which is directed towards the nasal cavity and prolonged upward into the bony processes which support the horns. The mucosa which covers them forms, in the vicinity of the median line, one or two folds which isolate some small spaces.

The rodents generally are not provided with frontal sinuses, but we have seen a small one in the Indian hog. Cuvier reports very large ones in the porcupine, in which they penetrated into the depths of the nasal bones.

The horse's frontal sinuses extend into the frontal bone and open into the posterior or internal compartment of the sinus maxillaris.

Baum (1894) has examined sections from the heads of 80 horses, and considers the communication established by the large opening between the frontal sinus and the maxillary to be physiologic.

They are very large in the elephant, and extend not only into the frontal, but also into all of the bones of the cranial vault. Anteriorly, the nasal and the intermaxillary bones are hollowed out by air spaces.

All of these bony cavities, partitioned and subdivided into cells, communicate with one another. A horizontal section across the head of an Asiatic elephant, to be seen in the new galleries of the Museum of Paris, shows beautifully the extent of all of these spaces.

Among the Carnivora, dogs, wolves and hyenas have very extensive frontal sinuses, which descend to the posterior wall of the orbit. They are less developed in the cat, being limited to the median part of the frontals.

They are less extensive in the cercopithecus, and are wanting in many monkeys.

Zuckerkandl (1887), after a comparative study of the frontal sinuses, established a distinction between the macrosmatic mammals and the microsmatic primates. The former have at least one excavation in the nasal portion of the frontal bone. The irregular distribution of the frontal sinus in the series of mammals does not appear to justify this classification.

In man the frontal sinus has the form of a triangular pyramid, its base being formed by the passageway between the squama and the roof of the orbit, and by the excavation of the nasal portion of the bone. A median sagittal partition separates the sinuses from one another. The volume varies considerably, even constituting a racial characteristic. In southern negroes it is greatly reduced. According to Steiner (1874) the frontal sinuses may have ethmoid cells included within them.

Boege (1902) considers the frontal sinuses as extensions of the ethmoid mucosa. They communicate rarely through the partition, 1 per cent of the cases. Two frontal cavities are rarely found on a single side, 1.5 per cent. They are absent in 4.9 per cent of the cases, an opinion which Poirier (1892) accepts.

Mouret (1902) has found several double frontal sinuses independent of one another; each of these opens singly into the corresponding nasal fossa; the more anterior one is considered as the principal sinus, the other, the nasal orifice of which is posterior to that of the former, is the supplementary sinus. The supplementary sinus, according to this author, is formed by a dilatation of the anterior ethmoidal cell, which he calls the posterior frontal bulla.

The frontal sinus opens, in common with the maxillary sinus, in an excavation of the middle meatus, situated upon the ethmoid and bounded by the bulla ethmoidalis and the uncinate process. Boyer has given to this depression the name of infundibulum. Zuckerkandl calls it the hiatus semilunaris. This space is accessible on account of the disposition of the inferior turbinal, which, at the level of its anterior extremity, is not adherent to the external wall, but hangs in the form of a triangular strip. (Raugé, 1894.)

Ethmoid Cells.—The ethmoid cells, which occupy the thick portion of the ethmoid bone, are spaces of small dimensions, communicating with one another; their number is very variable.

Simon Paulli remarks that the number of pneumatic cavities in the ethmoid has no relation with the total volume of pneumaticity nor with the size of the animals. In several carnivora, in the prosimians and platyrrhinans, the number of the cavities is restricted; it is important in many of the ruminants, and may be much reduced in many of the large animals (horse and hippopotamus).

Zuckerkandl found shallow ethmoidal cells when the ethmoidal turbinals were slightly developed (lower monkeys). In the orang a large hollow space is found, instead of cells, between the lamina papyracea and the wall of the ethmoid turbinals, communicating with the maxillary sinus.

Zuckerkandl has described these cavities in man; they are spaces situated between the ethmoidal turbinals, being of the nature of interturbinal meatuses. They are hollow cavities in the thick portion of the turbinals and the bulla ethmoidalis.

SPHENOIDAL SINUS.—The sphenoidal sinus is absent in a large number of animals, otter, seal, pole-cat, ruminants and cetaceans; it is very small in the pig and hippopotamus; in the horse it is the smallest of the sinuses and is partitioned; it is very small in the carnivora and in the monkeys. The rudimentary development in mammals, as remarked by Zuckerkandl, depends generally upon the fact that the sinus usually has no anterior wall and does not exist as a true sinus, but simply as a form of excavation or anfractuosity of the olfactory region of the nasal cavity. It is thus in the echidna, the marsupials, the edentates, the artiodactyles, with the exception of the pig, the rodents and the insectivora, which have a sphenoidal sinus in the form of a niche.

It often has for its function the lodgement of the olfactory projection. In microsmatic animals the sinus, which is empty, has an anterior wall with an ostium sphenoidale (Zuckerkandl).

In man it is a hollow cubical cavity in the body of the sphenoid, divided into two parts by a median partition, each cavity having an anterior orifice which opens into the corresponding nasal cavity.

The sphenoidal sinus is often limited anteriorly by lamellae called sphenoidal turbinals, which are portions of the ethmoid.

RESUME.—Most of the accessory cavities open into the nasal cavity at the level of the respiratory region (frontal, maxillary sinuses and anterior ethmoidal cells).

The maxillary sinus is very much reduced in the carnivora, the rodents and the edentates. It is replaced by a malar sinus in the pachyderms. It is very large in the ruminants, the solipeds, proboscidians, primates and man.

The frontal sinuses are absent in certain groups or in certain species (absent in the deer, well developed in cattle, sheep and the goat). They are absent or very small in the rodents. They open into the maxillary sinus in the horse, and they are very large in the elephant. They are absent in many of the monkeys. In man their volume is variable (absent in negroes of the south). They are formed by ethmoidal cells enclosed in the frontal (Steiner). The ethmoid cells are spaces of small dimensions communicating with one another. They are numerous in the ruminants, being much reduced in the horse and hippopotamus. They form a single cavity in the orang.

The sphenoidal sinuses are often lacking (otter, seal, ruminants and cetaceans) or much reduced (pachyderms, proboscidians, carnivora and monkeys). They often have for their function the lodgement of the olfactory projections.

The total volume of the accessory cavities in man is greater than that of the two nasal cavities, the relation being 144 to 100 (Braune and Clasen).

Organ of Jacobson.—Ruysch (1703), Sömmering (1809) described in man a canal corresponding to the organ of Jacobson, but without giving to it its significance. Jacobson gave a description of it in 1811 and it was studied by Cuvier and Gratiolet (1845).

Huschke noticed the paranasal cartilage or the cartilage of Jacobson. Dursy described this organ in 1869 and Kölliker (1877) noted the presence of the organ of Jacobson in the human adult. Remy (1878) made some observations in different mammals and confirmed the description of Cuvier. The orifice of the receptacle of Jacobson in the canal of Stenson has the form of a linear furrow, which recalls the orifice of the nasal canal in the middle meatus. Its mucosa is analogous to that which covers the nasal fossae.

Klein (1881) studied this organ in the India pig. It is a tube opening frontally into the canal of Stenson; behind it terminates in a cul-de-sac. It is enveloped by a hyaline cartilage which forms an incomplete capsule. The wall consists of epithelium, a fibrous subepithelial coat, a layer of cavernous tissue and a glandular layer. The epithelium, like that of the nasal cavity, is composed of a superficial layer of cylindrical or conical cells, between the extremities of which are placed fusiform or inverted conical cells. The superficial surface of the cells is provided with fine cilia.

Balogh has found the same epithelium in the sheep. The alveolar glands, are more developed in the region where the capsule is deficient.

In the rabbit Klein (1881) found an organ of Jacobson longer than that of the India pig. In the latter the organ is distinguished, moreover, by direct communication with the nasal cavities.

Harvey (1882) describes an analogous orifice in the mouse. The organ has no relation with the canal of Stenson. In the cat and hedgehog, on the contrary, there is a direct communication between the anterior extremity of the organ of Jacobson and the canal of Stenson.

Klein (1882) described the organ of Jacobson of the dog, which is placed in the inferior part of the septum, corresponding to a small prominence above which a larger one lies; it is the special ridge of the cartilage of Jacobson which causes the superior prominence. In a dog of average size the length of the organ is 3 cm. It does not open directly into the nasal cavity, but into the canal of Stenson by its anterior extremity. The latter is covered by stratified pavement epithelium; in the upper, large region, the most superficial cells are cubical. The intermaxillary bone has an important role in supporting the organ of Jacobson.

The cartilage which surrounds this organ is curved crescentically on transverse sections. The structure of the organ, studied in extensive detail by Klein, does not differ from that of the India pig or the rabbit, except that the cavernous tissue, so well developed in the latter animals, is absent in the dog.

Gegenbaur (1886) advances the opinion that the obliterated tube, which is considered in the adult man as a rudimentary organ of Jacobson, is an excretory canal of a nasal gland situated in the septum. It is removed from the cartilage of Jacobson, with which it should be in relation, and its situation corresponds to that of the septal gland of acinous structure, which is well developed in the prosimians.

Herzfeld (1888) published a very important work in which he discusses the presence or absence of the canal of Jacobson and of the naso-palatal canal, and the structure of the different parts of this organ. The following are his conclusions:

1st. The canal of Jacobson opens into a distinct naso-palatine canal in the ruminants (sheep, goat, ox), pig, dog, cat, mole, lemur, macaco and Hapale penicillata;

2d. No naso-palatine canal exists, but a diverticulum is found into which the canal of Jacobson opens (horse, ass);

3d. The naso-palatine canal exists, but the canal of Jacobson opens into the nasal cavity (rabbit, hare and rat);

4th. The nasal cavity is united to the buccal cavity by an open naso-palatine canal, the organ of Jacobson being wanting (bat, Pteropus edwarsi, Cercopithecus fuliginosus);

5th. Canal of Jacobson and naso-palatine canal both absent (seal). Man forms a group apart, for he possesses, at the level of the septal wall, the canal of Ruysch, which in other mammals is replaced by glands.

Herzfeld, in reference to the structure of the organ, notes the presence of a venous sinus situated laterally between the mucosa and the cartilage.

Symington (1891) describes the organ of Jacobson in marsupials; it is very well developed and resembles that found by Parker in the monotremes. It is a simple epithelial tube, communicating anteriorly with the naso-palatine canal, and surrounded by a cartilage in the shape of a "U." In the Ornithorhynchus, also studied by this author, the cartilage forms a complete tube in a large part of its extent. The organ extends anterior to its opening into the naso-palatine canal.

Potiquet (1891) studied, in the human adult, the canal of Jacobson, a vestige of the organ of the same name. It is found easily enough in the cadaver, at least when lesions of the mucosa do not cause its obliteration. He examined for it in the living. Although it is not as easy to discover it as in the cadaver, it was found quite often.

It is situated above a projection, elongated from before backwards, and constituted in part by the cartilages of Jacobson; it occupies the antero-inferior portion of the septum. A large number of affections of the septum (syphilides, ulcerations, perforations, repeated epistaxis) attack the region of the canal of Jacobson, perhaps indicating the localization of the pathologic process at this place.

Mathias Duval and Gernault (1895) made observations on the organ of Jacobson in the Cheiroptera; they noted its absence in the murin and in the horseshoe bat and they found traces of it in the embryos of the pipistrel. The canal of Stenson is closed early in the murin and horseshoe bat, but persists in the pipistrel.

Broom (1896) studied the organ of Jacobson in Echidna; the palatal cartilage contributes to form the cartilaginous framework. The cartilage has the shape of the letter "C" in its anterior part, and then takes the form of a complete ring.

A band of cartilage, the turbinal cartilage, in relation with the external wall of this cartilaginous tube, supports the glandular tissue.

The epithelium described by Broom is sensory in character. This author also examined the organ in the Ornithorynchus, finding differences in the disposition and extent of the cartilages.

Mikalhovics (1889) studied the organ of Jacobson, or vomero-nasal organ, in a certain number of mammals. In the mole the organ is located in a fossa of the vomer; the cartilage of Jacobson or paranasal cartilage is situated above the canal, and is not in relation with it. Some serous glands lie on the lateral side of the organ. On the caudal part, the glands are more numerous and the tube more narrow. Anteriorly it opens into the canal of Stenson and has a common cylindrical epithelium.

In the mouse it is independent of the paraseptal cartilage; anteriorly it opens into a groove placed above the canal of Stenson; it lies partially in the intermaxillary and partially in the vomer.

In Ungulata and Carnivora the organ of Jacobson is analogous to that of the rodents; it lies in the "C" shaped cavity formed by the paraseptal cartilage. In man the canal of Jacobson is present during embryonic life. Later it is represented only by the paraseptal cartilages.

Mangakis (1902) has observed in the human adult the organ of Jacobson, first described by Kölliker, then by Merkel and Anton. It was in a young soldier that Mangakis found this organ, which had the form of a canal and was 6.2 cm. long. The anterior orifice was visible without rhinoscopy. It communicated with that of the opposite side through the septum, the posterior opening, narrower than the anterior, lying free in the pharynx. Histologic examination of three fragments showed the presence of olfactory cells like those described by Merkel.

We made a microscopic study of the organ of Jacobson in the sheep. It is located in a longitudinal fossa of the vomer, opened considerably externally and superiorly. It is surrounded by a complete cartilaginous tube, which comes in contact with the nasal cartilage on its superior border. This cartilaginous canal is 3 mm. wide transversely, and 5 mm. vertically; its circular cavity has a diameter of 2 mm.

The organ of Jacobson, which fills it completely, is a cylindrical tube, the walls of which are 0.5 mm. thick and the lumen 1 mm. in diameter. The total length is 7.6 cm. The head of a sheep is 23.5 cm. long, and the nasal fossa 11 cm.

Anteriorly, the tube of Jacobson opens into the naso-palatine canal. It is widely opened, and at the level of the roof of the mouth it is widened into a fossa, and is directed towards the nasal cavity, obliquely across its floor. The opening of the organ of Jacobson lies concealed behind a mucous fold of the internal border, at the anterior extremity of the buccal opening of the naso-palatine canal.

We have studied the organ in the mouse, by histologic sections (Fig. 20). Its situation is, as in the sheep, in a fossa of the vomer. We found no cartilaginous envelope, but a thick fibrous wall. The organ presents walls of great thickness on transverse section, 128 mikra at the level of the internal wall, and 185 at the level of the external. In toto, it forms an elliptical mass, the diameters of which measure 400 mikra vertically and 357 transversely.

The lumen, elongated vertically and narrowed transversely, has the form of a crescent with concavity external, with a height of 178 mikra and a width of 28. The external wall forms, in the cavity, a convex ridge analogous to the ventral ridge of the organ in reptiles.

The walls are uniform throughout, and are formed by a thick cellular mass of closely applied polyhedral or round cells provided with a large nucleus.

The cells which border the lumen of the organ are much elongated and present two very distinct portions, one deep and dark, containing the nucleus, and an internal, very clear and homogeneous. The cells are not so high on the external wall as on the internal.

The organ of Jacobson in the cat lies below a large ridge of the septum. Its anterior opening does not enter a permeable naso-palatine canal, as this is closed by the buccal roof.

NASAL MUCOSA.—(*a*) *Macroscopic Aspect.*—Schneider (1645) gave the first exact description of the pituitary membrane. He refuted the ancient view which ascribed the flow to the discharge of liquid humors of the brain through the cribriform plate.

This mucosa covers the entire extent of the nasal fossae and sinuses; behind it is continuous with the pharyngeal mucosa, anteriorly with the skin. It is very adherent to the subjacent periosteum. Nevertheless it can be separated from it, and Remy rejects the expression "fibro-mucosa."

Its thickness varies according to the region; it is thinner in the olfactory fossa than in the respiratory portion, thicker over the inferior turbinals than over the other turbinals, with the exception of the inferior border of the middle turbinal in man.

Its internal surface is covered with mucus; it is smooth, but in the posterior portion Kölliker observed folds and ridges, directed from above downward and from behind forward. These folds are found only in the infant and disappear later. Its color is an intense red in the living, but it is not uniform. In the superior part it shows a yellowish color, noticed for the first time by Todd and Bowmann. The yellow color marks a region which the writers name regio olfactoria, and which Ecker has called locus luteus. It is in this region that the branches of the olfactory nerve end (M. Schultze, Ecker, Eckardt and Rémy). The color may be brown or yellow, depending on the animal.

The topographic situation of the olfactory region is easy to determine on account of this coloration, and besides, the histologic examination fixes it at about the same limits. We may say in general, that the olfactory mucosa covers the entire extent of the ethmo-turbinals and of the grooves which separate them, the nasal roof and the septum in the corresponding region. It extends only to the level of the naso-turbinal upon its posterior extremity; upon the external wall it never reaches the meatus subjacent to the inferior ethmo-turbinal.

In man this rule is verified, since the sensory mucosa comes to the inferior border of the middle turbinal (inferior ethmoidal turbinal). However, according to the researches of Max Schultze and Hermann Suchanneck, it is less extensive upon the middle turbinal and covers only the superior half, while Battista, Grassi and Castronovo (1889) found upon this turbinal a transitory investment between the olfactory mucosa and the respiratory mucosa.

The extent of the olfactory mucosa, expressed in absolute figures, whether dependent upon the number or dimensions of the ethmo-turbinals, is too much connected with the total volume of the head to give any exact notion. It is more interesting to compare it with that of the respiratory mucosa.

This relation will give a better idea of the peripheral extent of the olfactory organ. We have measured the extent of the two regions, olfactory and respiratory, in different animals. For this purpose we have cut paper squares of 4 mm. on each side, and, fragment by fragment, we have covered the entire surface to be measured, taking account of the hollows and ridges. If we do not arrive at absolute exactness, at least we have a sufficient approximation, for the points of error remain the same for both regions. The following are the figures which we have found in certain animals:

	Respiratory Surface.	Olfactory Surface.	Ratio.
Sheep	33.00 cc.	8.84 cc.	3.73
Guinea-pig	2.08 cc.	1.12 cc.	1.85
Rat	1.60 cc.	1.12 cc.	1.33
Cat	6.08 cc.	5.76 cc.	1.055
Dog	12.08 cc.	9.76 cc.	1.23
Monkey	9.76 cc.	4.16 cc.	2.34
Man	10.40 cc.	3.08 cc.	3.37

According to these figures, the dog, cat, rat and guinea-pig are macrosmatic; the sheep, monkey and man are microsmatic.

This classification agrees with those of Broca and Turner, which are based upon other anatomic conditions, such as the extent of the olfactory region of the brain.

Braune and Clasen, who measured the volume of the nasal cavities, found that the amount of air entering the olfactory region during sniffing was one-tenth of that passing through the respiratory region.

(*b*) *Structure.*—We can distinguish an epithelium and a corium containing glands, vessels and nerves.

EPITHELIUM.—The epithelium is the place in which the differences between olfactory and respiratory regions reside.

The epithelium of the respiratory region is composed of long, cylindrical cells, enlarged at one extremity and attenuated at the other, with a nucleus in the middle of the cells. The enlarged extremity of the cell has vibratile cilia, generally curved outwards. Below and between the deep prolongations are round cells. At the level of the nares, this mucosa is united to a covering which has all the characteristics of the skin. The transition is abrupt, according to Rémy.

According to Eckhardt, Ecker and Max Schultze, the epithelium of the olfactory region possesses two kinds of cells, viz., cylindrical and fusiform cells. Max Schultze described the fusiform cells as characteristic of olfactory epithelium. They are in intimate relation with the fibres of the olfactory nerve and are the peripheral ends of this nerve.

Cisoff (1874) saw the prolongations of the olfactory cells penetrate into the subepithelial layer, into which the fibres of the olfactory nerve also enter. It is rarely possible to demonstrate the fine nervous fibrils in communication with the olfactory cells, but Sidky (1877) admits this communication.

Von Brunn (1880) describes the fusiform cells as sensory cells in direct union with the branches of the olfactory nerve; he describes, on the surface of the epithelium, a homogeneous membrane (membrana limitans) which permits the peripheral prolongations of the sensory cells to pass through the pores.

Delavan (1880) and Tourneux (1883) found the same elements as Von Brunn.

Grassi and Costranovo (1889) studied the distribution of the varicose fibrils of the olfactory nerve of the dog; upon their entrance into the connective tissue of the mucosa, they divide into horizontal branches parallel to the epithelial layer; of these branches, there are divisions which enter into the olfactory cells, but some fibrils end directly in the cells without following a horizontal course.

Hermann Suchanneck (1890) gives an entire series of distinctive characteristics between the two epithelia, olfactory and respiratory, but he does not find the membrana limitans of Von Brunn. Ramon y Cajal finds that each olfactory fibril preserves its absolute independence from the olfactory bulb to the cell in which it terminates. It never anastamoses with the neighboring fibrils, and does not divide at any point in its passageway. The olfactory cell is a bipolar nerve cell, and its internal prolongation is a fibre of the olfactory nerve.

Fusari (1894), like Grassi and Costranovo, finds the same nerve fibrils passing into the basal prolongation of several olfactory cells. In the epithelium of the organ of Jacobson he observed that one portion of the fibres of the olfactory nerve entered directly into relation with the basal process of the epithelial cells. The others, at the base of the epithelium, were in relation with a globular nerve cell, which sent towards the periphery slender prolongations scattered between the epithelial cells.

Van Gehuchten (1890) agrees with Ramon y Cajal, that the fibrils pass directly into the olfactory cells without ramification, and after a slightly waving course. The nerve prolongation is continuous insensibly with the cellular mass, and at the other pole the protoplasmic substance forms a thick peripheral prolongation, which extends to the free surface of the epithelium.

The ordinary epithelial cells present a cylindrical peripheral portion and an irregular central portion, often terminating by bifurcation at the internal limits of the epithelium.

Disse (1900) has found, in the calf, olfactory buds lying upon the internal wall of the ethmoidal labyrinth, and upon a field corresponding to the septal wall. They are spherical in form and present a pore, open upon the surface of the mucosa, and enclose replacing and sensory cells.

The olfactory epithelium is thicker than the respiratory epithelium; in the mouse it attains a thickness of 128 mikra at the level of the olfactory fossa, and 21 mikra at the level of the external wall, below the naso-turbinal. The cells are of two kinds: fusiform, sensory united by varicose prolongations with the fibres of the olfactory nerve, and epithelial, supporting cells of cylindrical form.

The deeper shade of the olfactory region results, according to Tourneux, Hermann Suchanneck, etc., from the presence of colored granules in the epithelial cells, and according to Rémy, from infiltration of the corium by the fusiform bodies filled with yellow matter.

CORIUM.—*Glands.*—The connective tissue corium contains glands and vessels, distributed in an irregular manner.

The glands are particularly compact at the level of the lateral and inferior wall, where they attain a large size.

In the respiratory mucosa, according to Max Goerke (1897), there are numerous mucous as well as serous glands. The mucous secretion, by becoming dry, checks the movement of the vibratile cilia, so the very fluid serous secretion is of great utility in holding the humidity of the mucus. Schmincke (1902) has studied minutely the glands of the respiratory region in man, which are of a mixed type. He has followed the process of secretion in two kinds of cells; during the period of repose the albuminous and mucous cells are similar.

The lachrymal canal pours out the aqueous secretion of the lachrymal glands at the level of the inferior meatus; the humidity is still further increased in this region if exposed to the passage of a current of air.

In the olfactory region numerous glands are found (Bowmann's glands). In the mouse they form an important supero-internal group. According to Max Goerke, these glands never secrete mucus, an opinion concurred in by Heidenhein, who considers them as serous.

Von Brunn considers all of them as albuminous glands. Their excretory ducts open upon the superior nasal wall, and upon the portions in the vicinity of the lateral wall and the septum, in the recesses covered by ciliated epithelium.

The adenoid tissue, under the form of small follicles, is quite abundant in the respiratory mucosa; the migratory cells belonging to it are very much diffused (Stöhr), as are those in the olfactory region (Von Brunn). In the dog, cat, sheep, deer, pig, hare, horse and calf the diffused adenoid tissue is very abundant. The follicles attain a large size in the dog (Zuckerkandl).

VESSELS.—*Erectile Tissue.*—The arteries of the nasal mucosa have several trunks; the anterior nasal comes from the facial, the spheno-palatine from the internal maxillary, and the ethmoidal arteries from the internal carotid. Their ramifications have the type of spiral arteries. We have not undertaken their study in mammals. For the description of arteries in man see Zuckerkandl and works on anatomy.

The veins form efferent plexuses accompanying each of the arterial branches. Interest in the vascular system of the nasal fossae lies in the formation of venous networks, situated between the corium and the periosteum, and having the character of cavernous tissue.

Kohlrausch has described a venous network, rich in anastomoses, situated between the periosteum and the mucosa; Voltolini considers these networks as composed exclusively of veins and announced a theory of erection. Zuckerkandl's study (1895) in man is very complete. He observes that the nasal mucosa is thicker in such places as it comes in contact with a large quantity of air. For this reason, a true cavernous body is developed only on the inferior turbinal, on the border of the middle turbinal, and at the posterior extremities of the middle and superior turbinals. In the places where the mucosa is thin there is only a dense venous network, but no cavernous tissue. These cavernous bodies in the nose are formed of two networks; an external, composed of large venous vessels in communication with efferent veins, and a more delicate internal, in relation with the capillaries, which are placed in the system of laminous trabeculae, containing also some muscular fibres. The glandular culs-de-sac penetrate into the vascular layer, so that, while Langer compares the erectile tissue of the nose to the corpus cavernosum, Zuckerkandl compares it to the cavernous tissues of the urethra.

In the cavernous bodies of the penis, the trabeculae represents disassociated vascular walls and the muscles are irregularly scattered and have more the disposition found around veins. In the nasal mucosa the expansion of the veins into a vascular system is not so marked, and the muscular layer appears more regular.

Kiesselbach reports cavernous tissue on the nasal septum in man, in the region where the organ of Jacobson should lie. This is the locus kiesselbachi, which is very frequently attacked by hemorrhages.

Arviset (1887) and Isch Wall (1887) consider the erectile tissue of the nasal fossae as constituted primitively of capillaries, which later take on considerable development and undergo important modifications.

Isch Wall also found these capillary dilatations in the embryo of the pig, cat and mole.

In the human adult, he studied the cavernous tissue in an executed criminal. The middle turbinal was entirely occupied by lacunae which were very numerous in the corium, and which were distinguished from those of the penis by lessened thickness of the layer of smooth fibres. Towards the surface the tissue is formed by fine vascular meshwork; towards the depths by very large lacunae.

Herzfeld (1889) found that the cavernous body of the nasal mucosa is rich in smooth muscles and elastic fibres. The cartilages of the turbinals are spongy, and their lacunae communicate with the efferent veins of the cavernous tissue.

Pilliet (1891) found the erectile tissue composed of large, irregular cavities, the larger ones situated against the bones, the smaller in the corium. These are neither arteries, veins nor dilated capillaries, such as C. Robin describes.

The muscular elements are disposed in two different planes around the connective tissue walls, the more internal being longitudinal; but it is difficult to establish their direction, by reason of the bendings of the cavernous sinuses.

In the human fetuses examined from the fifth month to birth, no trace of erectile tissue is found In the younger embryos of the sheep, horse, pig and rat there is found, between the cartilage and epithelium, only a thick layer of connective tissue with stellate or elongated cells, studded with capillaries; the true erectile organs are developed in this manner (Nicholas). The observations of Retterer (1887) and those of Tourneux (1887) demonstrate that the region which is to be the seat of the erectile organ is for a long time characterized by the complete absence of blood vessels.

According to Boulai (1896) the vessels which groove the nasal mucosa are very muscular veins, but not erectile tissue; the development of these networks does not in any way resemble erectile tissue, the period of appearance being too early.

In the newly born dog and in the mouse, we have found, beneath the mucosa, a layer of connective tissue containing round and fusiform cells pressed together, between which are placed very large vessels with thin walls, running in various directions. On transverse section, some are found running transversely and others longitudinally or obliquely. These lacunae lie particularly at the level of the external surface, and especially along the free border of the inferior turbinal. At this point there are only venous dilatations.

Aviset found large vascular dilatations in the armadillo. In the buck, the corium of the mucosa contains arteries surrounded by a large number of capillary dilatations, which have neither muscular nor elastic coat. The glands of the mucosa are very rare in the region of the vascular dilatations; elsewhere they are abundant.

The camel, at the level of the septum, presents numerous glands, between which the vascular dilatations are distributed. The rabbit has only a train of dilated capillaries at the level of the septum; likewise the rat.

Pilliet found erectile tissue in the rodents and endentates. In the dolphin and cachelot, the corium, on the contrary, is thick, white, fibroid and very dense.

Arviset has observed that animals living in a wild state have a more abundant cavernous tissue than the domestic animals. This fact is in accord with the general development of the olfactory faculty.

The turgescence of the cavernous bodies of the nose is dependent upon the nervous system: the sphenopalatine ganglion, according to Zuckerkandl, is the vasodilator center for the nasal mucosa.

Hack has well shown the role of the nervous influence. Before Hack, Voltilini explained the erection without nervous intervention. According to his view, the vessels which constitute the cavernous tissue pass from the bony canaliculi, at the level of which the venous walls are wide open, and the blood enters the cavernous tissue constantly, through the vessels, which are always open.

But if the blood enter easily, it could leave easily, and erection is impossible, so Zuckerkandl judges this theory untenable.

En résumé, Are we dealing with erectile tissue in the nose or not? The true erectile tissue is composed of lacunae, interposed between arteries and veins, whose walls contain smooth muscle fibres (Robin, Tourneux). According to Retterer (1902) the adherence of the capillaries to a dense fibrous tissue especially characterizes the erectile tissue.

Arviset, Isch Wall and Herzfeld consider the vascular network of the nose as capillary dilatations. According to the observations of Kohlrausch, Zuckerkandl, Pilliet and Boulai, who corroborate our observations on the dog and mouse, the dilated veins and lacunae are not identical with those of the corpus cavernosum of the penis; Zuckerkandl compares them to the spongy tissue of the urethra. From a histologic standpoint, the vascular tissue is not true erectile tissue, but it may be said that it is a lacunar tissue, capable of increasing its volume.

By virtue of the presence of the spiral arteries and of a special vaso-dilator system, the afflux of blood into the lacunar tissue may be suddenly increased and the turgescence which results is sometimes considerable. Certain reflexes may provoke it.

The most interesting observations are those which connect the olfactory with the genital apparatus. In animals, olfactory excitations precede genital excitations, so erectile tissue is more developed in wild animals in which the sexual phenomenon is most intensely manifested.

Mackenzie has studied the relation between the nasal and genital organs in man and woman, which, according to him, will depend on the analogy of structure. The turgescence of the nasal mucosa, by a hyperesthetic effect on the nerve terminations, makes the most delicate impressions perceptible, on account of which the cavernous tissue is more developed in wild animals which have the need of great sensibility in order to smell their prey or to scent the female at great distances.

The influence of odors on the generative apparatus is very marked in the human species, according to Cloquet. "The care, which many women take in using perfume, seems to be a proof; she is wise in the art of pleasing, who does not allow anyone to see her until after she has aided her charms by the use of odors."

Fliess, and after him Schiff, Malherbe and other clinicians, have treated the painful attacks of dysmenorrhea by application of cocain tampons to the nasal fossae; they also destroyed, by cauterization, certain zones in the nasal cavity (genital points), and obtained satisfactory results. This is particularly effective in nervous dysmenorrhea. Malherbe, in cases of genital asthenia, excites the genital points in the nose by electric stimulation.

The inverse influence seems better demonstrated. Mackenzie has shown that excessive venery in man causes coryza, due to obstruction of the nares by the dilated cavernous bodies. According to this writer, repeated sensual excitations may cause inflammations of the nose. Isch Wall reports the case of two young people who were affected with epistaxis at each coitus, at the beginning of their genital life.

The accelerated, noisy respiration in the course of the venereal orgasm seems to indicate that there is a partial obstruction of the nasal fossae by the turgescent mucosa.

We have seen chronic coryza in several women affected with retroversion of the uterus, which is always accompanied by utero-ovarian congestion.

It is only rarely that women breathe normally through the nose, but sleep with their mouth open, during their menstrual periods.

LYMPHATICS.—Well studied in man by Sappey and then by Simon (1859). The latter found in the nasal fossa the justification of a law proposed by Sappey, that the lymphatics of a region are more abundant as its sensibility is more developed.

The lymphatic network of the septum ends by six to eight trunks in the lymphatics of the lateral walls. There it exists as a superficial network at the level of the superior turbinal, of the anterior half of the middle turbinal and of the space in front of the turbinals; a deep network with larger meshes is in the remaining portion of the lateral wall. The efferent trunks converge in a fossa placed between the Eustachian tube and the posterior ends of the turbinals. In the nares there is a network independent of the preceding, the efferent trunks of which run parallel to the facial artery.

NERVES.—The trigeminal (branches of the ophthalmic nerve and of the spheno-palatine ganglion) innervates the respiratory region. The branches of the spheno-palatine ganglion are the vaso-dilators of the nasal mucosa.

The olfactory nerve, divided into numerous branches, is distributed to the olfactory mucosa, and we know its relations with the epithelial cells of this region. Its branches pass into the nasal fossae through the cribriform plate of the ethmoid. They are covered by prolongations, in the form of sheaths, of the coverings of the brain, which accompany them into the mucosa. It is a true nerve center placed at the periphery.

The olfactory cells are nerve cells derived directly from the ectodermic cells. Their protoplasmic prolongations form the olfactory cilia; the prolongation of the axis cylinder is a fibre of the olfactory nerve. It goes to form the connection with the protoplasmic prolongation of the interpolated neuron, the cellular body of which lies in the olfactory bulb. This last establishes the relations with the cerebral centres.

The central olfactory nerve apparatus varies according to the osmatic power of the animal, and this depends upon the olfactory bulb with its convolutions. According to Zuckerkandl, the following organs are reduced in animals with rudimentary olfactory lobes and in man: the gyrus hippocampi, the lobe of the corpus callosum in the region of the isthmus and the fold of the retrolymbic passage, the convolution of the corpus callosum, the anterior perforated lamina, the horn of Ammon, the external marginal convolution, and finally the internal marginal arc. In the dolphin, which is truly an anosmotic animal, in opposition to the preceding, which are microsmatic, the brain presents: complete absence of the olfactory lobe, a decided regression of the basal portion of the lymbic lobe, complete absence of the anterior perforated lamina, reduction of the horn of Ammon to an extremely faint rudiment, complete absence of the fimbria, and a considerable regression of the external marginal arc.

CHAPTER II.

EMBRYOLOGY.

Amphioxus.

Hatschek (1884) asserts that the ciliated fossa corresponds to an ectodermic recess in which the anterior neuropore opens; it persists for some time without closing. The depression is united with an evagination of the left intestinal diverticulum which fuses with it. Thus constituted, the olfactory organ of Amphioxus represents two organs of Craniata: the olfactory organ and the hypophysis.

In this last homology, Hatschek finds a difficulty in the entodermic establishment of the hypophysal tube in Amphioxus.

According to Dohrn, the anterior primitive olfactory invagination becomes dorsal by the extraordinary development of the upper lip.

Willey considers the ciliated fossa of Kölliker as the homologue of the hypophysis of Craniata.

According to Kupffer this fossa corresponds to the median olfactory plate of the embryo of Acipenser. Amphioxus is the only primitive monorrhinal vertebrate.

Legros (1897) has extensively studied the morphology of the head of Amphioxus. The stomodeal fossa is, at the beginning, a large cavity (preoral fossa) which is separated into two parts by a fold of the entoderm. The antero-superior portion gives origin anteriorly and to the right, to a short diverticulum, the fossa of Hatschek, which is directed forwards; behind and to the left, to a narrower diverticulum, the nephridium of Hatschek, which is directed backwards. These two organs are the respective homologues of the olfactory fossa and of Rathke's pocket of the Craniata. Kölliker's fossa represents the portion of the ectoderm which corresponds to the neuropore of the embryos of Craniata. But it is not, as claimed by Hatschek and Willey, the homologue of the hypophysis of Craniata.

Fish.

1. CYCLOSTOMES.

The study of the morphology of the olfactory apparatus shows a great difference between the cyclostomes and the other vertebrates; it is the monorrhinals against the amphirrhinals. This anomaly exists during embryonic life, even from the beginning of their development.

HISTORICAL.—Scott (1882), contrary to Calberla, describes the primitive imparity of the olfactory outline. This appears as a slight depression above the mouth—the common invagination of the nasal fossa and the hypophysis. The ectoderm, simply thickened at first, has very high cells; then, when the fossa is formed, those at the bottom are increased in height, while those of the opposite walls remain very low.

Kupffer (1894) was concerned in demonstrating the primitive amphirrhinal character of the Monorrhina and found two series of plakodes on the head; a dorsolateral and an epibronchial series. The two series converge anteriorly upon a terminal anterior plakode, which exists in the amphirrhina as well as in the Monorrhina. But in the Monorrhina it is invaginated, becoming a groove. At the passage which it forms there is a point of continuity between the brain, before its complete isolation, and the ectoderm.

In Petromyzon larva of 3.5 to 4 mm. in length, a fibrillary cord is found, destined soon to disappear, which unites the summit of the olfactory sac to the single olfactory lobe.

This disappears, and paired olfactory nerves are formed, which, without doubt, are homologous with those of Amphirrhina. But these paired nerves correspond to a single olfactory sac.

Calberla had alreay expressed the opinion that these nerves, which come from two symmetrical halves, are an index of the duplex character of the nasal organ.

Kupffer, from the standpoint of the single plakode, finds paired plakodes which are at first feebly developed and distinctly separated from the terminal plakode. Invaginations, which are produced and prolonged from them, are utilized for the formation of the olfactory sac. These paired portions affect the duplex character of the olfactory nerve in Petromyzon. No difference exists between the Monorrhina and the Amphirrhina.

Wilhelm Lubosch (1902), in Ammocetes of the eighth day, found the brain completely detached from the ectoderm. At the passage where the last point of union existed, the ectoderm was thickened and formed a single olfactory plate. On the 12th day a groove appeared in this olfactory lamina. Between this thickening and the hypophysal plate, an intermediate plate was found. This lies lower and permits the olfactory plate to project.

In the myxinoids, Kupffer found as the olfactory beginning a median plakode, placed ventrally in relation to the orifice of the neuropore. The final development does not differ from that in the Petromyzon. However, in place of terminating in a cul-de-sac, the cavity opens on the roof of the digestive cavity and communicates with it.

According to Götte, this canal of the Monorrhina is conserved in the Amphirrhina under the form of the cerebral prolongation, called the hypophysis; but Dohrn separated the two formations from one another.

Observations.—We have studied some young stages of Petromyzon planeri of 2 to 6 mm., but we have not been able to conclude our series. The nerve tube is well outlined in embryos of 4 to 6 mm. On its anterior extremity, it is in relation with a thick cellular mass, which, moreover, is connected with the ectoderm. This is the single plakode of Kupffer. On transverse and frontal sections, we have not seen the lateral thickenings of the ectoderm in connection with the single epithelial mass. Thus we find in the cyclostomes and in Amphioxus an olfactory beginning different from that of other mammals.

This same observation has been made by Scott and Wilhelm Lubosch, who describe only a single outline.

This is not the opinion of Kupffer, who describes three plakodes as the primordial olfactory outline in vertebrates.

Amphioxus, according to him, is the only one to possess a single plakode; all the others have a single plakode and paired plakodes.

Thus, in the Monorrhina (cyclostomes), the single plakode plays a great role in the formation of the olfactory organ, the others taking little part in the extension and becoming fused to the first.

On the contrary, in Amphirrina (gnasthostomes), the single plakode is visible only during a short period of development.

However, Kupffer represents the single plakode as present in Acipenser, Acanthias, frog and sheep.

But many observers contradict this. In the figure of Acanthias by Miss Platt there is no local thickening of the horny layer and no plakode. The ectoderm in the anterior region of the head is almost wholly thickened and the opinion of Kupffer is not verified (Karl Peter).

In the amphibians, Götte describes a median thickening which he considers as the outline of the hypophysis. Corning and Hinsberg thought that this thickening was a frontal ray.

In birds, Van Wijhe did not find any median thickening.

Peter (1901), in the lizard, found a thickening upon the ventral portion of the lips of the neuropore, but this thickening did not have in its structure any characteristics of the sensory plakode; besides, it was never in relation with the lateral olfactory region. Moreover, it appeared in its formation to be related to a mechanical cause, as it is found at the place where certain organs (crystalline lens, auditory vesicle) are detached from the ectoderm; there is, therefore, no special significance in its formation at the level of the anterior cerebral vesicle. Karl Peter, on the other hand, denies the existence of this median ectodermic thickening in mammals.

Two facts, only, remain in favor of the primitive parity of the nasal organs of the cyclostomes: the duplex nature of the olfactory nerve, announced by Calberla, and the presence of a median septum, presented by Langerhans in support of this idea.

We have very, distinctly observed the existence of two olfactory nerves in Ammocetes (see Morphology, Fig. 3) and the presence of a median septum (Fig. 2). It is, therefore, necessary to admit that two distinct areas give origin by their precocious fusion to the formation of the median single thickening. The mesoderm is only interposed between the two olfactory fields, as in the other vertebrates. The primitive dorsal situation of the areas favors this evolution.

In résumé, the Monorrhina are vertebrates with dorsal olfactory anlage, while in all the other groups we will see that it is primarily ventral.

The origin of the hypophysal diverticulum is due to the neuroporal thickening, according to Götte, Scott, v. Wijhe (1884, 1886) and Wiedersheim (1902). The naso-palatine canal in lampreys and mixinoids appears to correspond more to this nerve formation than to the choanal canal of air-breathing vertebrates.

SELACHIANS.

HISTORICAL.—Balfour (1878), in his monograph on Elasmobranchia, speaks of the first appearance of the olfactory organ as a double thickening of the ventral epiblast. Milnes Marshall (1879) found a pair of thickenings of the external layer, below the surface of the anterior brain and immediately above the mouth. Each thick point evolved as a fossa; the bottom of this is very close to the brain. Ziegler indicates also the olfactory area. Holm (1894), in the torpedo, showed the origin of the olfactory organ depending upon ectodermic thickenings, placed laterally in relation to the neuropore. They are united to the brain by a cellular cord formed of elongated elements, while those which constitute them are formed of round embryonic cells. The brain, which is separated from the thick ectodermic zone, retracts and leaves it, and forms an olfactory nerve or ganglion. Hoffman (1896) indicates the zone of fusion between the anterior extremity of the medullary tube and the epidermis as the point of departure of the olfactory outline. Above the neuropore, this point of fusion is absorbed in part, but it persists as bridges of delicate plasma, at the place where the olfactory nerves are formed. In young embryos, the beginnings of the olfactory nerve are very close to one another, then they separate. The olfactory nerves can be well seen in an embryo of 13.5 to 14 mm. Up to this period, the olfactory groove lies close to the medullary wall. Mesenchymatous tissue is interposed between these two formations, and the olfactory nerve is increased in length in embryos from 18 to 20 mm. At the same time the groove is deepened. The borders of the groove approximate in embryos of 22 mm. and in embryos of from 27 to 28 mm. the base of the groove begins to be provided with folds.

Kurt Berliner (1902) published a long work on the development of the olfactory organ of selachians. He examined some embryos of Acanthias, Pristiurus and Spinax niger.

The olfactory beginning appears in Acanthias of 3 mm. length. In a Pristiurus of 5 mm. the outline is represented by a cellular plate of two or three layers. The ectodermic condensations have no relation with the neuropore; there is no possibility of a monorrhinal beginning, according to the idea of Kupffer. The olfactory plates increase by cellular multiplication, and it is the deep sensorial layer which alone enters into this development.

There is an invagination which increases progressively in depth and forms a cul-de-sac. Its borders are constituted by two cutaneous cushions. The olfactory organ, at first in the neighborhood of the neuropore (Acanthias of 3 mm.), is directed more and more towards the ventral side, and always retains this situation. The formation of cutaneous folds is due to an active proliferation of the indifferent ectoderm in the neighborhood of the olfactory organ.

The ridges of the mucosa, or folds of Schneider, appear in Acanthias at the stage of 25 mm. of length. Their formation appears to be due to the spontaneous multiplication of the internal wall of the sensory groove, rather than to the pressure of the mesodermic tissue.

Description of Stages.—We have examined a series of embryos of Pristiurus in the youngest stages, from 2 mm. in length, and some specimens of Scyllium canicula from 3 to 3.5 cm.

Pristiurus Melanostomus, 3 *mm. in length*.—The central nervous system is represented by an elliptical tube, flattened laterally, with walls of regular thickness formed of round cells crowded against one another. The ectoderm is formed by several layers of round cells. The optic vesicle is present, and is placed behind and below the nervous system. There is no trace of the olfactory anlage.

7 *mm. in length* (Fig. 24).—The nervous system is a tube of very large lumen with slightly thickened walls. The optic vesicle is well developed. Below this, and at the level of the latero-ventral part of the nervous tube, the ectoderm presents a considerable thickness very much extended in the dorso-ventral direction. The thickness has the form of a disc, the borders of which are confounded gradually with the surrounding ectoderm. This is the olfactory anlage, which is composed of very small round cells. The central region of the

disc is slightly depressed and is of maximum thickness. The nuclei of the most superficial layer are far removed from the surface, so that the outline is bordered posteriorly by a layer of clear, finely granular protoplasm.

12 *millimeters* (Fig. 25).—The nervous tube and the optic vesicle have attained a high degree of development. The ectoderm is composed of several layers in regular order. The mesenchyme below the ventral surface of the nervous system is more compact, and surrounds an elliptical mass composed of round cells analogous to those of the ectoderm. A very large cavity occupies the center of this mass, thus transformed into a vesicle, as seen in transverse section, passing 40 mikra behind the preceding. The cells which border the lumen of this vesicle present the same characteristics as those which lie at the surface of the olfactory outline in the 7 mm. stage; their central part is clear and they are of cubical form. This cavity changes in form and becomes more irregular in proportion as we approach the posterior regions, situated at a

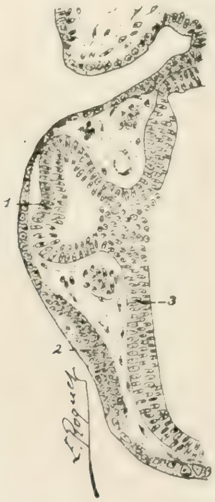

Fig. 24—X 95. Pristiurus melanostomus 7 mm. (right side). 1. Eye; 2. Olfactory outline; 3. Central nervous system.

distance of 140 mikra from the anterior extremity. The ventral surface penetrates into the cavity under the form of a conical ridge, and at each of the antero-external and postero-external extremities, the epithelium rises in very low folds, into the interior of which the mesenchymatous cells are insinuated.

Behind and above the ridge of the ventral wall, a large epithelial tract unites the vesicle with the ectoderm. Behind this epithelial tract, the vesicle communicates freely with the exterior. This orifice is limited by the borders of the primitive fossa. It is narrow, and it forms a sort of canal of an average height of 170 mikra. At this level, which is almost the middle region of the olfactory cavity, the epithelial folds are very numerous and occupy a very large portion of the bottom

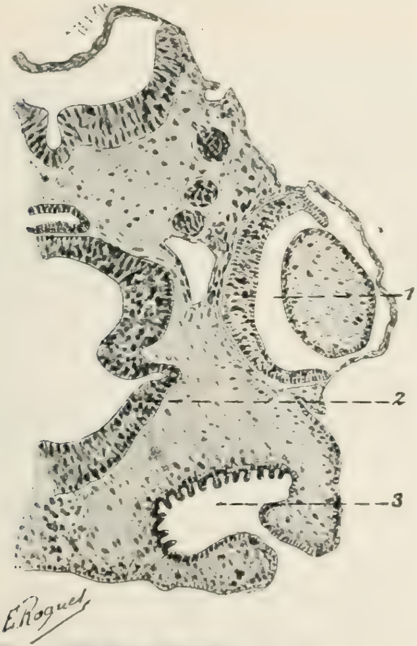

Fig. 25—X 34.3. Pristiurus melanostomus, 12 mm. long (appearance of lamellae in the olfactory cavity; left side). 1. Eye; 2. Nervous system; 3. Olfactory cavity.

of the cavity. In the most posterior sections (Fig. 25), the entire bottom is found occupied by folds, the height of which varies from 30 to 60 mikra, and which are separated from one another by plainly visible, deep fissures. The external orifice of the olfactory cavity is opened at the level of the border of the head, upon the ventral surface.

A little behind, the groove is less deep and opens freely externally, its borders not being limited by the canal. The walls are simple and without folds. Then, behind the groove, lies a slight depression, at the edge of which the ectoderm is unmodified.

The buccal depression begins a short distance behind the olfactory cavities.

In the regions where no folds exist the epithelial cells have still the embryonic character, while they lose it at the level of the folds, where they are more elongated, but still without a well defined form.

22 *Millimeters.*—As in the preceding stage, the olfactory outline begins anteriorly by a solid cellular mass. At the center of this the cells converge by their clear, finely granular extremities. The cavity appears in this cellular mass 110 mikra behind. The cavity in frontal sections is seen closed over an extent of 50 mikra, and then it opens externally by a large orifice. In passing from before backward, the fossa is enlarged and becomes less and less deep, its borders becoming attenuated and confounded with the neighboring ectoderm. Our frontal sections do not manifest any folds of the epithelial wall.

The cells of the superficial layer are quite cylindrical, and have an average height of 24 mikra. Their central portion is finely granular and clear, their color is rose gray (colored by alum carmine), while the peripheral portion is deepened and contains a strongly colored nucleus.

The nasal organ has not undergone displacement towards the lateral surface of the head; it is always situated under the infero-external border of the central nervous system. There is still no trace of cartilaginous skeleton.

SCYLLIUM CANICULA, 30 *Millimeters* (Fig. 26).—The external forms are those of the adult animal; the nasal orifices are hollowed upon the ventral surface of the head, anterior to the buccal opening, and are placed at a level anterior to that of the eye. The nervous system is completely developed; below the ventral surface of the anterior cerebral vesicle, in the midst of the mesenchyme, is seen a series of small cavities elongated in a dorso-ventral direction, constituting the anterior extremity of the olfactory apparatus. These cavities are increased upon more posterior sections, and are finally united to form a single cavity. The common portion is extended transversely and the preceding cavities run vertically. The walls which separate these cavities are nothing more than epithelial folds which have become higher and transformed into large lamellae.

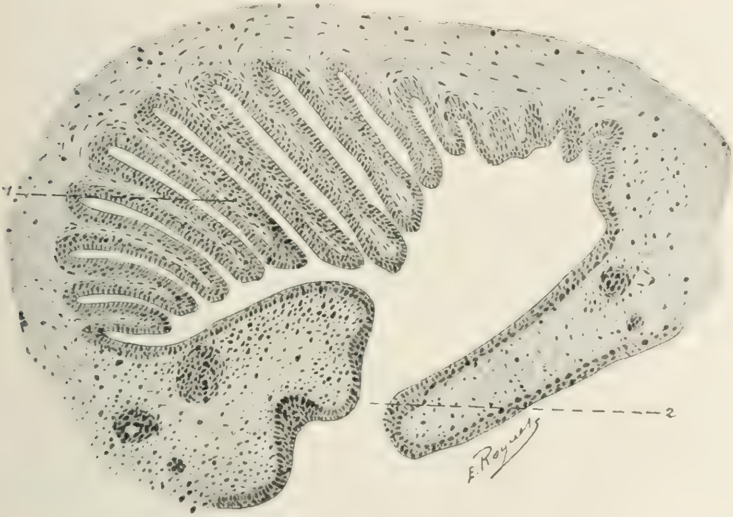

Fig. 26—X 70. Scyllium canicula (transverse section showing the lamellae inserted on the dorsal wall of the nasal cavity; right side). 1. Lamellae; 2. Nasal orifice.

A large cartilaginous tract, placed transversely, separates the ventral surface of this cavity from the ectoderm.

In the external third of the cavity, a large epithelial cord unites this wall with the ectoderm, and posterior to this the cavity opens externally (Fig. 26).

The nasal opening is contracted on account of the development of its borders, which approach one another and limit it into a narrow slit only 35 mikra wide at the point of greatest contraction. They are in the same plane as the ventral surface of the head. At a more posterior level, the borders of the groove limit an irregular canal with thin epithelial walls, which run obliquely into the nasal cavity. This is prolonged posteriorly from the orifice of entrance and is arranged as above.

The cartilaginous capsule is quite incomplete, only a portion of the ventral and dorsal walls being present. There is a trace of the septum.

The epithelium at the level of the ventral wall, and upon the border of the canal of entrance, is formed of round or cubical cells crowded together, and arranged in two or three layers. The lamellae, which are inserted perpendicularly upon the dorsal wall of the cavity, have a height varying from 178 to 500 mikra. At the level of the lamellae, and in the bottom of the grooves which separate them, the epithelial layer presents a superficial stratum of cylindrical cells. The axis of the lamellae is formed by the mesenchyme, composed of fusiform same as mesenchyme cells. The posterior portion of the nasal cavity is subjacent to the bulbus oculi.

OLFACTORY BEGINNING.—The olfactory organ appears in a very early stage in the selachians. Ziegler found it in the torpedo 3 mm. long; Balfour in Pristiurus and Scyllium of 6.5 mm.; Berliner in Acanthias of 3 mm. and Pristiurus of 5 mm.

We find in Pristiurus of the 7 mm. stage a very extensive olfactory outline, under the form of ectodermic thickening in several layers, occupying a large portion of the latero-ventral surface of the embryo.

This outline has been found by Holm and Hoffmann under the lateral portions of the ectodermic thickening of the neuropore.

Milnes Marshall (1879), Ziegler and Berliner (1902) found the outline placed below the central nervous system.

This ventral situation, or, more exactly, latero-ventral, can be well seen in Fig. 25; it remains during the stages of evolution.

According to Berliner, the olfactory outline is constituted by the multiplication of the deep or sensory layer of the cells of the ectoderm. Our observations indicate that the entire thickness of this layer is indifferently employed in the development of the nasal thickening. In fact, the most superficial cells of the outline of the stage of 7 mm. present the characteristics which we find later in the cells which limit the olfactory cavity (Fig. 24). These are the cells of the surface which border the depression or olfactory fossette, and at a stage somewhat advanced, the cavity results from the union of the borders of the groove.

Moreover, at no point of the ectoderm is it possible to distinguish two morphologically different layers.

EVOLUTION OF THE OLFACTORY ORGAN.—The surface of the olfactory plate is grooved, and, by virtue of the continued deepening, it becomes a deep cul-de-sac. This last is surrounded on all sides by thick ectoderm. Anteriorly, the cellular mass grows into the mesenchyme, and the cavity is enlarged so as to form a sort of vesicle. The depth of this cavity presents a series of folds of the epithelial wall, into the center of which the mesenchymatous cells penetrate. These folds, which are the outlines of the folds of Schneider, appear in Pristiurus of the 12 mm. stage; Berliner finds them in Acanthias of 25 mm.

From the time when the modifications of the epithelium appear, it is cylindrical at the level of the superficial layer of the folds, at the intermediate grooves in the 12 mm. stage, and at the orifice of entrance. The borders of the latter are elongated under the form of thick ridges converging in such a manner that the external border is concealed by the internal border; the external nasal orifice, instead of opening largely externally, is found transformed into a narrow and oblique canal.

Berliner (1902) shows, with great detail, the role played in the development of the nasal cavity by the multiplication of the cells in the olfactory outline and the elevation of the indifferent ectoderm.

It is to the cellular multiplication of the olfactory thickening that he accords the primordial role. The edges of the groove are developed, not in order to increase the cavity, but to increase the ventral wall and accordingly to narrow the external opening.

The olfactory organ, situated ventrally in the beginning of its appearance, holds this situation and is always found anterior to the buccal cavity.

III. TELEOSTS.

HISTORICAL.—His, Hoffmann, Holm and Kopsch studied the olfactory apparatus in Salmonidae family, Balfour and Parker in Lepidosteus, Kerr and Semon in the Dipnoi.

The organ begins as a thickening of the ectoderm placed on the ventral surface of the embryo, in front of the eye. According to Holm (1894) the cells of this outline are distinguished at an early stage from the neighboring embryonic cells by their elongated form. This writer studied the connection of **the** olfactory nerve lobe with the ectodermic thickening and assisted in the understanding of the olfactory nerve by separating its two formations. The organ begins in the salmon (Salmo salar) from the 28th to the 30th day. Kopsch (1898) recognized its first appearance in the trout at the stage of eighteen primordial segments.

The ectoderm being composed of two layers, the deep layer alone gives origin to the olfactory plates, and the superficial layer passes above their rudiments but does not participate in their formation any more than it participates in the formation of the crystalline lens and the auditory vesicle. Three processes are involved in the changes taking place in the olfactory organ: the growth of the organ, the modifications in the surrounding epidermis, and the changes in the sensory epithelium itself.

The organ is displaced from the ventral to the dorsal side. At first it is placed below the eye, later, anterior to it. On both sides of the groove are developed two prolongations, which confine at first the nasal orifice, then by fusion give rise to the two orifices. While the posterior orifice remains simple, the anterior becomes a long canal which, according to His, is formed by two median folds.

Balfour and Parker in Lepidosteus show the beginning of the olfactory organ as a marked thickening of the sensory layer without participation of the superficial.

Semon finds, in Ceratodus, ridges dividing the olfactory grooves, directed towards the buccal cavity. One of the orifices of the nasal cavity will sink into the buccal region—it is the first step towards the adaptation of the nasal cavity to the respiratory function.

Our investigations were made on the salmon trout, and on the rainbow trout for older stages. There is considerable difference in the duration of the evolution of these two species. At Clermont, the eggs of the salmon trout, placed in running water at 9°, are hatched in sixty days. At Pointis-Inard, at the home of our friend, Dr. Cardeilhac, the rainbow trout was developed in thirty days in water of 14°; thus, the specimens of one and two months which we have examined correspond to the much older stage of the salmon trout.

Stages of Development.—*Salmo trutta—22nd day* (After fecundation.)—The external covering, well developed, presents several layers of cells, but it is impossible to distinguish two different strata. The interior of the embryo is occupied by agglomerated round cells without differentiation, and by the outline of the nerve tube. There is no optic vesicle or olfactory field.

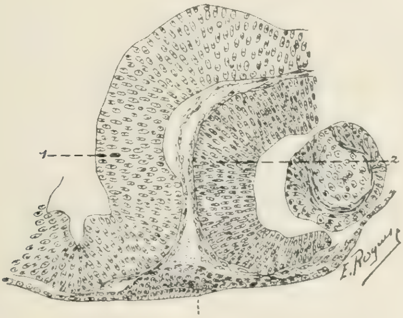

Fig. 27—X 70. Egg of salmon trout, 34 days after fecundation (olfactory outline presenting differentiation of the cells of the superficial ectodermic layer; left side). 1. Nervous system; 2. Eye; 3. Olfactory outline.

34th day (Fig. 27).—The optic vesicle is large and well-formed and the neural tube is of large dimensions. The inferior surface of these formations is very close to the ventral ectoderm. In the short space between the optic vesicle and neural tube, the ectoderm shows a thickening in the form of a disc (Fig. 27). This is the olfactory anlage, its transverse extent is 285 mikra and its thickness 57. The superficial cells, at this level, have already undergone differentiation; they take on a cubical or cylindrical form, and their protoplasm is similar to that of the embryonic cells.

52nd day.—The anterior part of the outline is a simple ventral thickening of the ectoderm; the cells which constitute it are elongated, perpendicular to the surface and distinguished easily from the adjacent ectodermic cells. No distinction is possible between the superficial and deep layers—the entire thickness of the ectoderm is concerned. A little posterior, the surface of the outline is depressed into a fossette and this grows, taking the form of a vesicle at a more posterior level. Then the mass becomes solid and is separated from the corresponding ectoderm. The buccal fossette does not correspond to the region of the olfactory outline, but is shown only a little more behind. The olfactory cavity lies between the optic vesicle and the lateral wall of the neural tube.

55th day.—There is little difference from the preceding stage; the olfactory vesicle is a little larger, its walls are uniformly thick. The length of the solid olfactory mass which prolongs the cavity is very considerable, and the ectodermic covering is detached for a greater length.

3rd day (after hatching).—No modification up to this time. The olfactory organ, which is always ventral, is placed on a transverse plane anterior to that of the eyes.

9th day.—The lumen of the nasal cavity is enlarged; the cartilaginous skeleton makes its appearance. The nasal organ begins to be directed towards the lateral surface of the embryo.

30th day (Fig. 28).—The nasal cavity is placed somewhat towards the middle of the lateral surface; it has the form of a simple pit, 100 mikra in extent from its anterior extremity. The borders which limit it are considerably elevated, due to the increase of the indifferent ectoderm. The cavity is closed and of cylindrical shape, with a length of about 70 mikra, then, behind, it is prolonged by a solid cellular mass. The epithelium which covers the bottom and the lateral walls of the fossette, and further the entire cavity, presents a superficial layer of cylindrical, much elongated cells. The buccal cavity has advanced to the region of the olfactory organ; the ventral wall of the latter is about 280 mikra distant from the buccal roof.

The cartilaginous skeleton has acquired a great development and has the form of an X on transverse section. An inferior branch separates the organ from the buccal roof, the superior branch separates it from the central nervous system and the point of union of the four branches forms a sort of median septum some distance from each olfactory cavity (Fig. 28). The optic vesicle is in relation with the posterior extremity of the nasal apparatus behind which it is situated.

30th day (Fig. 29).—The body of the animal has the form of the adult. The olfactory cavity opens on the dorsal surface by a large orifice (172 mikra transversely), and it lies on the anterior extremity of the olfactory organ, the solid cellular mass which existed in the preceding stages, being distinctly hollow. The ventral wall makes a projection into the cavity under the form of a thick fold, 228 mikra at the base and 321 mikra high across its middle portion. This ventral fold lies only in the opened portion; behind the nasal orifice, the lateral walls have each a narrow, slightly elevated fold. The epithelium is thick throughout the ventral wall and the fold comprised by it; it is thin over the lateral and superior walls.

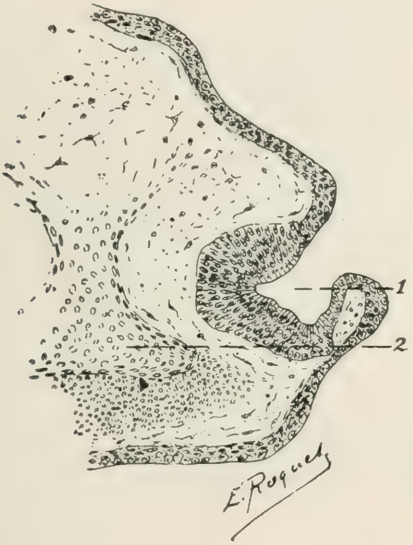

Fig 28—X 68.5. Salmon trout, 30 days after hatching (olfactory fossette presenting differentiated sensory cells throughout; left side). 1. Olfactory fossette; 2. Outline of cartilaginous skeleton.

2 months.—The nasal sac has an irregular, triangular form; its walls sink into the cavity. A very long fold lies on the internal wall at the level of the external orifice. Behind, the folds are numerous (3 or 4 depending on the section considered); they are all inserted along the bottom of the cavity. Their folds or lamellae have the structure which we have described in the adult. The dorsal situation of the nasal organ is definitely acquired; it is entirely in front of the eye.

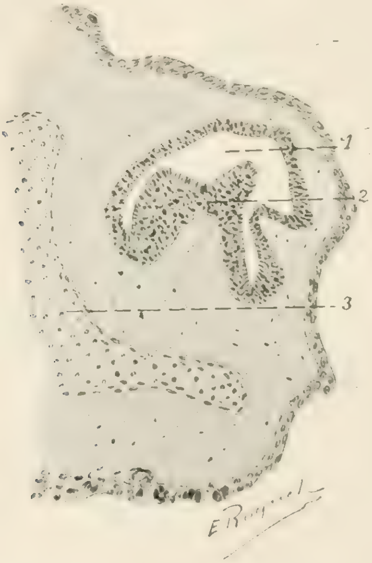

Fig. 29—X 68.5. Rainbow trout, 30 days after hatching (olfactory cavity presenting ventral folds with the outline of the lamellae; left side). 1. Nasal cavity; 2. Folds of ventral surface; 3. Cartilage.

A bony arrangement separates it from the buccal cavity, from which it is henceforth very far removed.

Evolution of the Olfactory Organ.—The olfactory apparatus is exceedingly simple, a solid outline which is transformed into a pit and vesicle. Its origin from the ectoderm is very well marked by the differentiation of the epithelial cells in this region. We have been unable in any stage to distinguish, at the level of the ectodermic thickening, the superficial epithelial layer from the remainder of the ectoderm. This layer appears concerned in its entire thickness in the development of the nasal anlage. The increase in size of the cavity and its displacement towards the dorsal surface are the principal transformations. At an advanced stage, the wall is raised and forms the lamellae, which are better developed in the adult. There is no trace of glands or of diverticula in the cavity. Madrid Moveno (1887) has studied the histologic transformations of the nasal mucosa in a series of fishes having the olfactory buds described by Sophie Pereyaslawzeff and Blaue. (Belone, Trigla hirundo, Zoerus vivaparus, Cyprinodon caloritanus.)

A disc of homogeneous sensory epithelium is primitively in the bottom of the olfactory fossette.

Soon an islet of pavement epithelium appears in the middle of the disc; this later becomes a fold. Other islets are established, extend and unite with one another in such a manner as to divide the olfactory epithelium into small fields. These olfactory fields, more or less small and numerous, are composed of supporting and sensory cells.

The neighboring pavement epithelium surrounds them in such a way that they communicate with the exterior only by a narrow orifice.

In fish such as the trout, eel, perch, etc., in which the epithelium is deprived of olfactory buds, the modification of the epithelium consists mainly in the appearance of folds, such as Kopsch has observed in the trout.

The olfactory fossette, on the 52nd day of incubation, is covered with long cells which circumscribe the lumen, while the deep cells preserve the characteristics of round embryonal cells. The differentiation of the round cells is extended throughout the groove. In the posterior region, where the olfactory outline is represented by a small vesicle with thick walls, the differentiation does not extend to the external wall of the vesicle.

On the ninth day after hatching, the long olfactory cells do not occupy a large portion of the olfactory cavity; the external portion only is covered with round cells.

The disposition of the elements is still the same on the 30th day in the salmon trout (Fig. 28). On the 30th day folds may be seen on transverse section, passing through the middle of the vesicle (Fig. 29) in the rainbow trout. The whole internal portion, folds and intervals, and a portion of the dorsal and ventral wall present a very thick epithelium with superficial, long, cylindrical cells. The other portions of the cavity are covered with epithelial cells, round in the bottom and flat towards the lumen. This arrangement remains definite.

The enlargement of the olfactory cavity, after the ninth day, results not only from the multiplication of the cells of the olfactory mass and their membranous disposition to cover the fossette of invagination but also from the growth of the borders of the fossette, which are only welded together after forming extensive folds.

Amphibia.

HISTORICAL.—Born, Burckhardt, Seydel, Bawden, Brauer and Sarazin studied the evolution of the nasal cavity in old embryos.

Goette (1875) made a complete study of the series of stages in a remarkable work on the development of Bombinator.

He found the ectodermic cells, at the beginning of the development, arranged in two layers: the covering or superficial layer, and the sensory subjacent to it. The beginning of the olfactory organ is a thickening of the sensory lamina. On each side, this appears as a depression in front of the fore brain and below the inferior portion of the primitive optic vesicle. Portions of the middle layer are placed between the eye, the brain and the olfactory organ, but its situation remains lateral in relation to the anterior extremity of the brain. The external layer is invariably separated from the basal layer formed of cylindrical cells; soon they are fused into a single cellular mass, in such a way that the entire external coat forms the bottom of the olfactory organ. The ectoderm adjacent to the posterior border of the thick olfactory lamina is raised into a fold which increases the external wall of the nasal fossette, while the olfactory lamina forms the median wall. The superior portion of the olfactory cavity remains open, the bottom directed backward is narrowed in the form of a slit and is fused with the anterior portion of the buccal roof. The posterior orifice opens in this place.

In opposition to Rusconi and Van Bambecke, who claim that the whole nasal fossette forms the olfactory organ, Goette considers only the thick part forming the median wall as the sensory organ.

Corning (1889) describes the two layers of ectoderm, the superficial and the nervous, and indicates in detail their individual characteristics.

The olfactory thickening is established as a medullary plate. At this level, the two layers of the ectoderm are at first distinct, then they are intermingled so that it is difficult to determine what part of the formation is derived from the superficial and what from the nervous layer.

The olfactory organ thus differs from the auditory, the crystalline lens and the organ of the lateral line.

The fusion of the two layers is already effected in embryos of 6 mm.

Strasser (1901) reports only the role of the mesoderm in the situation of the olfactory organs.

Hinsberg (1901, 1902) gives a long description touching all the stages of development of Anura, Urodela and Gymnophiona.

The olfactory thickening of Rana fusca comprehends only the sensory layer of the ectoderm, the superficial layer regressing at this level. The olfactory lamina increases its ventral portion and reaches the buccal epithelium. By the removal of the cells, a round lumen appears at the postero-superior pole of the olfactory lamina, as well as in the ventral prolongation, and then a communication is established between the buccal groove and the nasal lumen. The choana thus formed lies behind the vestige of the pharyngeal membrane, consequently in the ectodermic region of the buccal cavity.

The olfactory fossette, increased in dimensions, takes on a funnel-shaped form; it is continued posteriorly and internally by a canal terminating in a cul-de-sac. Ultimately the cul-de-sac enlarges, becoming the middle lumen.

En résumé, the nasal cavity is composed of three genetically different parts: 1. The dorsal lumen, a round canal situated at the superior pole of the olfactory lamina, covered on all sides by sensory epithelium. 2. A slit made by dehiscence, which forms across the ventral prolongation of the olfactory lamina and communicates with the buccal groove—the ventral lumen. 3. The middle lumen, constituted by the differences in growth between the olfactory lamina and the epidermis.

The ultimate changes at the neighborhood of the external orifice consist in an increase in the length of the middle lumen, and a retraction of the orifice itself, which has an annular thickening on its circumference, having the function of a valve. The choana is modified by enlargement transversely.

Hinsberg does not attribute to the cul-de-sac the value of an organ of Jacobson, accorded to it by Born and Seydel.

The establishment of the middle lumen is simultaneous with the lachrymal opening and we must therefore think of a causal coincidence between these two facts. A large glandular conglomeration appears at the beginning of the metamorphosis on the lateral nasal wall, anterior to the lateral appendix. A second forms on the posterior border of the choana, corresponding to the pharyngeal gland of Born.

The formation and evolution of these different culs-de-sac have been studied at length by Hinsberg.

The beginning of the olfactory lamina in Urodela, as well as Anura, is a thickening of the sensory lamina; the disappearance of the superficial layer is also more distinctly recognizable. The primitive nasal cavity is more simply established; it increases longitudinally, while in Anura it increases dorsoventrally.

The lumen of the olfactory fossette corresponds to the middle lumen in Anura. The external orifice is displaced towards the lateral part by a sort of rotation of the axis of the nasal canal. On account of this rotation, the external cul-de-sac of the triton corresponds to the inferior cul-de-sac of the frog.

Hinsberg has studied the development of the olfactory apparatus in Gymnophiona, the first stages in Hypogeophis rostratus, the more advanced stages in Ichthyophis glutinosus.

The sensory lamina is still alone the site of thickening. While Brauer, insisting on the development of the external forms, finds a persistent groove between the lateral and median frontal buds, forming a slit between the mouth and the nasal cavity, Hinsberg has not observed a canal of this kind, but finds the naso-pharyngeal canal formed later into a cellular cord which at first was entirely solid. Nevertheless, by the formation of the choanae, Gymnophiona approach more nearly the Mammalia than any other Amphibia. Hinsberg also noted an inferior cul-de-sac, which had been described by Sarazin as an organ of Jacobson, but he does not accept the opinion of this writer.

Peter's (1902) article in Hertwig's work on comparative and experimental embryology is principally based on the investigations of Hinsberg.

Description of the Stages.—We have examined two series of embryos, Bufo vulgaris from the 2.5 mm. stage to the complete disappearance of the tail, and Rana esculenta from 4 mm. to the beginning of the metamorphosis.

Bufo vulgaris.—*Tadpole 2.5 mm. in total length.*—The ectoderm is formed by several layers of cells pressed upon one another, all round and without regular disposition in the successive strata. The most superficial are filled with pigment, which forms a brown border, the pigmentation sinking in places and forming spots in the deep portion.

The ectoderm is very thick on the ventral surface of the embryo.

The nervous system is represented by a small tube with a thick wall detached from the ectoderm. A compact cellular mass fills up the remainder of the body. A separation exists between this mass and the external coat, marked by a circular fissure. There is no trace of sensory outline.

Tadpole of 3 mm.—The nervous system represented by a round tube with thick walls throughout its circumference; appearance of the optic outline, an evaginated vesicle of the neural tube, of which the walls are very thick anteriorly and posteriorly; no trace of olfactory outline.

Tadpole of 4 mm. (Fig. 30).—The ectoderm presents a strongly pigmented external border and a layer of round cells, between which short, pigmented cells extend. The nervous system is represented by a tube, very high on transverse section, with thick lateral walls. The buccal invagination is well-marked. The olfactory outline exists under the form of a thick zone projecting inwards from the ectoderm. The cellular multiplication is especially active at the level of the deep layer, but the pigmented cells constituting the superficial layer do not disappear at the level of the thickening.

The surface is slightly depressed on the anterior part of this olfactory zone. The olfactory outline is placed at the level of the latero-ventral angle of the neural tube. The middle and posterior part are subjacent to the cellular mass which becomes the optic vesicle (Fig. 30).

Tadpole of 6 *mm.*—The anterior extremity of the olfactory outline is a solid cellular mass, into which the ectodermic depression penetrates with an increasing growth from before backwards. The pigment is localized in the superficial layer but is found in the bottom of the depression.

The buccal invagination, which is large and deep, has a roof formed by a thick epithelial layer. The olfactory region, depressed into a fossette, has a length of 80 mikra; then its borders approach and limit a closed cavity. It has a narrow lumen, and its dorsal, internal and ventral walls have an average thickness of 70 mikra, while the external wall is only 14 mikra in thickness. Its ventral extremity is elongated towards the buccal epithelium, and the two walls, nasal and buccal, are fused to an extent of 40 mikra, antero-posteriorly. Behind, the nasal cavity, in the form of a fissure, opens into the buccal cavity, the first appearance of the choana.

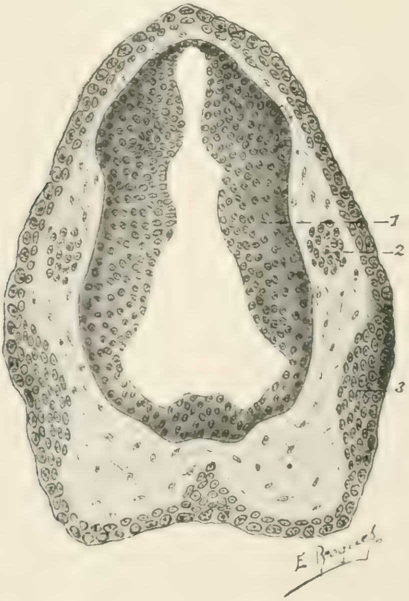

Fig. 30—X 95. Toad, tadpole, 4 mm. long. 1. Central nervous system; 2. Outline of the eye; 3. Olfactory outline.

There are to be recognized in the nasal walls pigment cells which indicate well the participation of the superficial ectodermic layer in the olfactory development. Within the nasal cavity there are some cartilaginous intervals.

Tadpole of 7 mm.—The olfactory outline presents an anterior portion detached from the ectoderm. The nasal cavity is more prolonged posteriorly and the dorsal and internal walls attain a very great thickness. There is a very slight diverticulum of the external wall, which is very thin.

Tadpoles of 8 and 9.5 mm.—The olfactory outlines do not present any important modification.

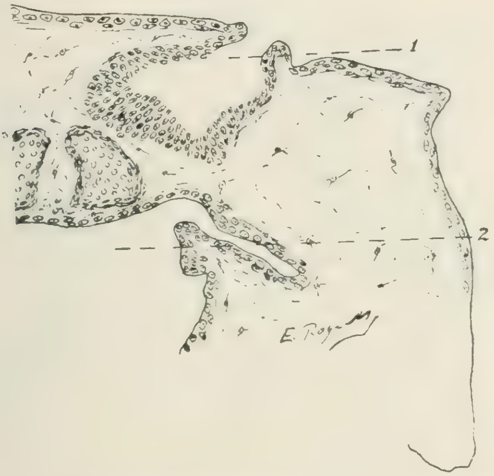

Fig. 31—X 68.5. Toad, tadpole, 13.5 mm. (left side). 1. Olfactory fossette; 2. Buccal cavity.

Tadpoles of 10 mm.—Olfactory mass very voluminous, lumen spacious, dorsal and lateral walls thick. The expansion of the cavity which penetrates the ventral cellular mass is large; the lateral diverticulum is of slight depth. Some cells of the internal wall are cubical, the nuclei are far removed from the surface and the protoplasm is clear.

Tadpole of 13.5 mm. (Figs. 31 and 32).—Anterior to the ectodermic depression corresponding to the olfactory fossette, the cellular mass which limits the bottom of it is prolonged as a cylindrical mass, isolated from the ectoderm for a distance of 40 mikra. The olfactory fossette is of large dimensions, 250 mikra deep and 164 in width (Fig. 31). The opened portion extends antero-posteriorly 120 mikra, then the cavity is closed. The internal and ventral walls are very thick. The lumen is formed of two diverticula, one of small importance directed outward, the other directed downwards. The latter is arranged as in the stage of 6 mm. It increases in depth from before backward and opens into the buccal cavity (Fig. 32).

In its anterior part, the nasal cavity presents a lumen formed by an almost elliptical central portion and three diverticula; a dorsal, an external and a ventral. Behind, it is elongated dorso-ventrally and narrowed from above downwards. It is situated entirely in front of the eye, and its posterior extremity is in relation with the central nervous system.

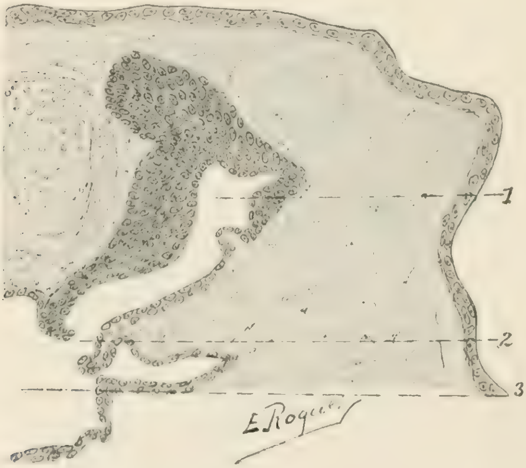

Fig. 32—X 68.5. Toad, tadpole, 13.5 mm. (transverse section **of the** posterior region of the nasal cavity, passing through **the choana;** left side). 1. Nasal lumen; 2. Choana; 3. Buccal cavity.

Tadpole of 16 *mm.*—The dorsal region of the olfactory vesicle has undergone a transverse enlargement, which is represented in transverse sections by external and internal culs-de-sac. The nasal cavity is behind the choana, shown in an antero-posterior direction. Over the whole internal wall there are long cells, some cylindrical, some cubical.

Tadpole of 20 mm.—The olfactory fossette appears to acquire a position more and more dorsal. The mass constituting the ventral prolongation is hollowed into a lumen by the simple removal of the cells at the level anterior to the choana.

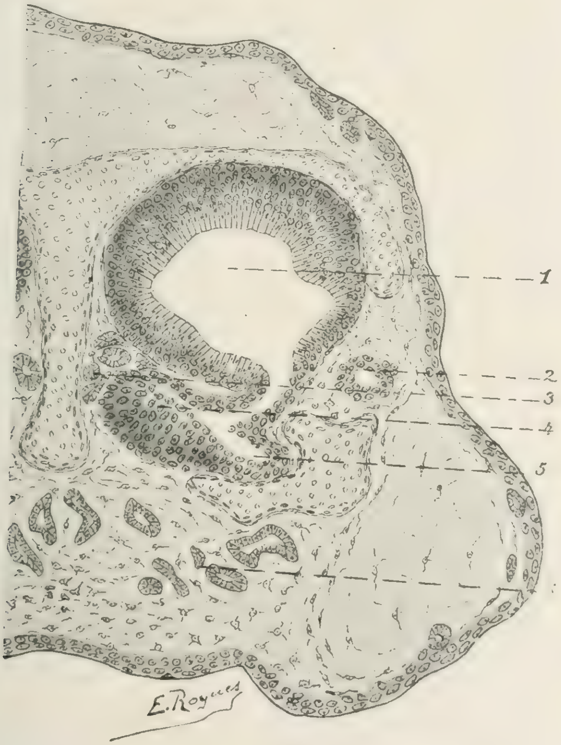

Fig. 33—X 68.5. Toad, tadpole, with four feet and a long tail (transverse section, showing the inferior cul-de-sac, glands and the lachrymal canal; left side). 1. Principal nasal cavity; 2. Lachrymal canal; 3. Gland of Jacobson; 4. Organ of Jacobson; 5. Infero-external cul-de-sac; 6. Palatal glands.

The first differentiation is effected in this cellular mass while it is exclusively composed of round cells. Throughout the internal wall, the superficial cells elongate, become cylindrical and are arranged in regular layers.

Tadpole having four feet and a long tail. (Fig. 33) The nasal orifice is placed on the border of the dorsal surface of the cephalic region; it gives access to a deep fossette, the epithelial wall of which has a more regular thickness than in the preceding stages.

Behind the external opening, the cavity has an elliptical form in transverse sections, and it sends out an external diverticulum, of small importance. Its long axis is directed transversely.

The nasal cavity communicates through the middle of its ventral wall with a small cavity which is subjacent to it (Fig. 33). The orifice of communication is situated 250 mikra from the anterior extremity of the organ. It has an antero-posterior extent of about 80 mikra; traversely, its extent is increased as we pass backward. The inferior cavity, to which it gives access, is nothing but the ventral diverticulum seen in the preceding stages, which has acquired now a large expansion and a disposition approximating that of the adult. This diverticulum extends anterior to the orifice of communication for a distance of 120 mikra, and passes parallel to the ventral surface of the nasal cavity.

In the largest portion, the lumen of this diverticulum has a tranverse extent of 357 mikra. Its internal wall is much thicker. The canal, by which it communicates with the nasal cavity, opens at the middle of its superior wall. It has this disposition for a distance of 150 mikra and then it forms a large groove opening upwards into the nasal cavity. This enlarged portion ends in the choana.

The superficial cells have a cylindrical form throughout the nasal cavity, those of the dorsal and internal walls being the highest (from 57 to 71 mikra). In the vicinity of the ventral diverticulum, the cells gradually lose their height, becoming cubical and then flat. The epithelial investment of the inferior diverticulum has still the embryonal characteristics.

Numerous glandular culs-de-sac lie below the inferior diverticlum, throughout the transverse extent of the palatal vault. They are separated from the nasal organ by an incomplete cartilaginous lamina.

Others, less numerous, lie between the internal border of the inferior diverticulum and the nasal septum, and another group against the external wall of the nasal cavity.

In the middle of these last glandular tubes, the section of the lachrymal gland is distinguished (Fig. 33).

The glandular cells, of cubical form, have a basal extremity containing the nucleus, and a clear central extremity with homogenous contents; they appear to be of a mucous nature.

The metamorphosis comes to its end; the animal already adapted to amphibian existence, perfects the respiratory apparatus by the appearance of these glands.

We may see the relation of the olfactory apparatus to the neighboring organs, by a series of sagittal sections. It is always situated in front of and below the eye, and above the buccal roof. The length, dorso-ventrally, of the olfactory mass establishes the continuity between this mass and the buccal epithelium, then the nasal lumen discards the cells of inferior prolongation, the epithelium is resorbed and the communication is established. The antero-posterior extent of the nasal cavity and of its ventral diverticulum is inconsiderable; this latter appears destined to establish the bucco-pharyngeal communication. In a series of horizontal sections comprising all of the body of the embryo, we have seen that the choana opens into a true fossa of the buccal epithelium. In its middle portion, the nasal cavity is separated from the buccal region by a cartilaginous wall.

We see it open externally; at this level the cartilaginous wall of the cranium separates it from the nervous system. A little higher, an interruption in the cartilaginous capsule permits the passage of the olfactory nerves, which arising from the anterior pole of the anterior cerebral vesicle, already divided into two hemispheres by a sagittal groove, enters the internal wall of the olfactory vesicle at the level of its anterior third.

In a more dorsal section, the olfactory apparatus is represented only by a solid mass situated in front and only a very short distance from the brain. At this level, the eye seems far behind the olfactory mass.

RANA ESCULENTA. *Tadpole of* 4 *mm.* On the lateral surfaces of the cephalic region, there is a lightly depressed ectodermic zone; the entire thickness of the ectoderm is involved. At the level of the groove, the deep layer, composed of round cells, crowded upon one another, presents a distinct thickening, which is continued backwards and downwards into the mesenchyme. The neural tube exists, and the olfactory fossettes correspond to its latero-ventral surfaces. The buccal depression does not exist in this stage.

Stage of 5 to 9 mm. Evolution of the olfactory outline analogous to that of the toad. The choana is plainly shown in the 9 mm. stage; in the preceding stages, the lumen already penetrates into the ventral cellular mass and comes in contact with the buccal epithelium.

Tadpole with two feet. The spacious nasal cavity presents, anterior to the choanal region, three diverticula of large antero-posterior extent: one is directed externally and opens into the superior part of the cavity; another, directed internally and superiorly opens in the middle portion and is surrounded by a very thick epithelial wall; finally the inferior diverticulum ends in the choana. Numerous glandular culs-de-sac lie internal and below the internal diverticulum.

APPEARANCE OF THE OLFACTORY OUTLINE. Corning found the cells of the two indistinct ectodermic layers participating in the formation of the olfactory epithelium in an embryo of Rana fusca, 6 millimeters long.

Hinsberg observed the first condensation of the sensory layer in a tadpole of Rana fusca, 3 mm. long.

Our results in Rana esculenta and Bufo vulgaris are almost identical. The first traces of the olfactory mass appeared in tadpoles 4 mm. long.

It is a thickening of the ectoderm which represents the olfactory beginning; it is composed of a mass of round cells having the characteristics of the deep cells of this coat. The superficial pigmented cells preserve their characteristics at this level.

The ectodermic zone, thus modified, lies upon the lateral portions of the head on each side of the neural tube (Fig. 30); the buccal depression still does not exist at this period, but the eye is already formed; it is placed dorsally in relation to the posterior extremity of the olfactory mass.

EVOLUTION OF THE NASAL OUTLINE. During the first stages, the olfactory apparatus of the Amphibia appears as that of fishes; it is formed as a thickening of the ectoderm which is depressed into a fossette. This increases in depth and its borders approach by cellular multiplication, limiting a narrow orifice, the external nasal opening. The groove penetrates the cellular mass, the elements of which disappear, the internal and posterior walls alone remaining thick.

The lumen appears in the zone which results from the growth posterior to the nasal outline and which remains isolated from the neighboring ectoderm, and at this level the nasal cavity has the appearance of a vesicle, isolated in the mesenchyme. The olfactory mass, hollowed in its middle portion, solid anteriorly and especially behind, approaches the buccal roof by its posterior extremity. It is situated below the eye and central nervous system. Up to this point there is no difference from animals breathing water exclusively. Little by little, the animal is prepared for air breathing; the olfactory mass is elongated in its ventral portion and forms a solid prolongation. Then a lumen appears in this latter—the ventral diverticulum.

The ventral prolongation joins the buccal epithelium and the diverticulum lengthens, the two cavities, buccal and nasal communicating with one another. First there is cell proliferation, then fissuration with removal of the cells appears, increases and ends finally with the formation of the choana.

The bucco-nasal relation is established by a peculiar, one might say, intrinsic process, without participation of the ectoderm as in Amniota, which have an external naso-buccal fossa or groove. Götte (1875) observed the beginning of this process in young specimens of the toad. Hinsberg (1901) could not find this process in Rana fusca and we have not seen any trace of it in the frog or toad.

Two processes must be admitted in the appearance of the nasal lumen: the ectodermic folds which limit the olfactory fossette and the hollowing of the olfactory mass by the removal and compression of the cells. We must not be exclusive as Götte, who attributes all importance to the first factor and as Hinsberg who accepts the second only.

The first process is concerned in the beginning, for the purpose of forming the superficial fossette in the thickness of the ectodermic mass and then, when the pigmented layer is indistinct, the second process is brought into play to increase the cavity, already acquired.

It is this process of fissuration which creates a lumen in the ventral bud. This latter becomes hollow from its anterior portion, and in the posterior region, where it unites with the buccal epithelium, it is completely perforated and constitutes the canal of communication between the two cavities. The lumen which exists anterior to the choana has the form of a groove, opening above into the nasal cavity. In old tadpoles, with four feet, this is only a simple groove, which is hollowed in its inferior prolongation—a diverticulum extended transversely.

This is evidently the inferior cul-de-sac of Born. We have, in the chapter on Morphology, shown the importance of the inferior cul-de-sac, which is a formation destined to increase the respiratory region. In a series of embryos, we have observed in fact that this inferior lumen appears by a hollowing in a cellular bud, which has no other purpose than to reach the buccal epithelium so as to establish bucco-nasal relations, and in consequence to open an air passage. And it is in the vicinity of this respiratory zone, which must be lubricated and moistened, that the first glandular formations appear.

The advanced stages have been well studied by Born in Pelobates fuscus and Rana fusca. He devotes a long description to the buds of the nasal cavity and to the diverticula which perforate them. These are superior, lateral and inferior; the superior corresponds to the true nasal cavity, the lateral receives the opening of the lachrymal canal and the inferior constitutes the maxillary cavity.

Hinsberg finds these culs-de-sac and insists upon their significance. He does not accept the opinion of Born with regard to the inferior cul-de-sac; it also appears to him difficult to consider it as the homologue of the organ of Jacobson, as Fleischer, Sarazin, Burckhardt (1891) and Seydel (1895) claim. The points of difference in the development and the later appearance in Amniota do not permit homology with this organ. But because of the sensory epithelium which this cul-de-sac contains, Hinsberg attributes to it the same functions as the organ of Jacobson. There is analogy but not homology between these two formations.

Besides, in the course of development, he observed "a lateral appendix" arising from the postero-superior wall, appear and disappear.

Our sections show the inferior diverticulum, and external to it a lateral diverticulum, which pushes into the region where the glandular evaginations of the external gland (superior of Born) are formed.

EVOLUTION OF THE NASAL CAVITY OF URODELA AND GYMNOPHIONA. In these two groups, Hinsberg (1901, 1902) studied the beginning of the development. The olfactory outline is constituted, as in Anura, by a thickening of the ectoderm, localized in the sensory layer. Brauer observed in Gymnophiona the nasal apparatus begin in a very slight fossette of almost triangular form. The buds of the facial mass distinctly participate in the constitution of the olfactory apparatus.

Between the median and lateral frontal buds, a groove is gradually formed, which brings the nasal fossa in direct communication with the buccal cavity. The choana, by an earlier establishment, will utilize a naso-pharyngeal ectodermic canal in its constitution. According to the researches of Sarazin, there is, in the ventral portion of the cavity, a sensory epithelial mass which corresponds to the organ of Jacobson in form and location. Hinsberg found this diverticulum representing the inferior cul-de-sac in other Amphibia.

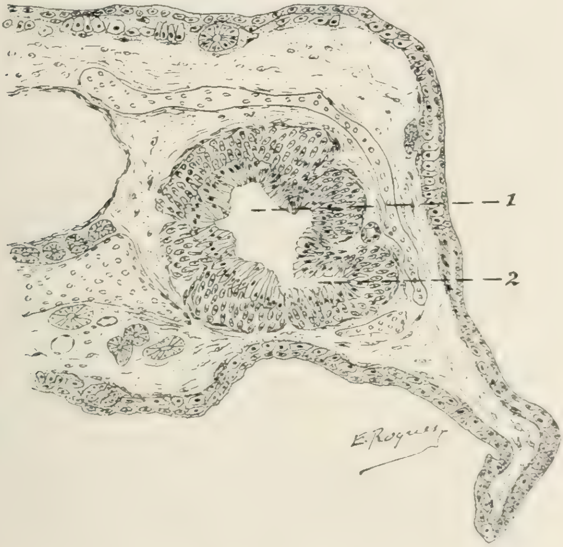

Fig. 34—X 68.5. Triton, still having branchia (transverse section, left side). 1. Nasal cavity; 2. External furrow.

The ectodermic thickening in Urodela appears more in the form of a button than in Anura, and the dorso-ventral addition does not exist. Hinsberg explains this difference by the form of the head and the location of the olfactory outline. The head is flatter, and the outline lies at the point of the anterior extremity of the buccal cavity, and not dorsally as in Anura. The increase in the direction of the axis of the body brings the primitive nasal cavity in contact with the buccal epithelium by removal of the mesoderm.

The caudal prolongation will be hollowed out of a lumen, like the ventral prolongation of Anura, and later the naso-buccal communication will appear. A cul-de-sac arises from the inferior wall, which ultimately acquires a lateral position by displacement of the axis of the nasal cavity; this is the inferior cul-de-sac. A slight evagination exists on the lateral wall which is to receive the lachrymal canal, but it remains in the state of a simple groove, while in Anura it forms the lateral cul-de-sac.

Burckhardt (1891), in old embryos, and Seydel (1850) and Born (1838), in the adult, homologized the inferior cul-de-sac with the same cul-de-sac of Anura and the organ of Jacobson of Mammalia.

We have been able to examine only the triton, in advanced stages of evolution, but still provided with gills. The external nasal orifice lies almost exactly in the middle of the lateral surface of the head, and corresponds to the anterior extremity of the nasal cavity. This has the form of a vesicle with thick walls, circular on transverse section; it opens into the buccal cavity by its posterior extremity. At this level, the ventral wall, very near to the buccal roof, is united to the latter; the nasal lumen penetrates into the zone of union and communication is established by a very simple process (Fig. 34).

The nasal lumen is prolonged radially by narrow diverticula or canaliculi which force away the constituting cells from the wall. Certain zones have the appearance of a cavity cut out by lamellae, as in fishes. At the level of the infero-external angle, the cavity sends out a lateral diverticulum which is hollowed into an evagination of the epithelial wall (Fig. 34). This diverticulum, which is very extensive antero-posteriorly, constitutes a groove enlarging the nasal cavity, and terminating behind in the choana. This is the inferior cul-de-sec of Born, Seydel and Burckhardt. It retains the same situation in the adult, and we have already indicated its functional significance.

REPTILES.

HISTORICAL. Rathke (1839) published a monograph on the development of the lizard; Parker (1879) studied the skull of the common snake; Born (1883) described the development of the nasal cavity of Lacerta agilis and Tropidonotus natrix. The beginning of the olfactory organ, as described by Rathke, is a small circular zone found on the ectoderm, under the cerebral hemispheres. A fossette is formed in this zone. External modifications are brought about by the development of the face (frontal and maxillary bud). A groove appears at the ventral extremity of the median wall of the nasal cavity in the stage of 47 intervertebral segments in the lizard; this is the first appearance of the organ of Jacobson. The external and internal nasal buds are formed at the expense of the frontal and approach one another; the point of the external nasal buds unites with the external surface of the internal nasal bud. Above this is only a punctiform orifice, which is the external nasal orifice. Below the bridge of fusion, the internal nasal orifice is formed and the bridge of fusion forms the primitive palate, which is increased in such a manner that it pushes the internal orifice more and more posteriorly. This transformation is well seen in Fig. 2, Pl. IX (1883).

Born (1883) gives a lengthy description of the formation of the palate; the superior maxillary bud sends out a median prolongation which unites with the septum except in its anterior portion, where the organ of Jacobson opens. These formations and their line of fusion extend backward, increasing the length of the palate and displacing the choana. The turbinal, a ridge which penetrates into the cavity, is formed on the external wall of the nasal cavity at the level of the maxillary bud. The formation of the lateral nasal gland, the relation of the lachrymal canal with the space subjacent to the turbinal, and, the distribution of the sensory and stratified epithelium are the subjects of detailed study. Plates IX and X of his work (1883) show the relation of the different buds of the face and their changes as well as their orifices and the relation of the cavity with the organ of Jacobson.

Orr (1887) represents the olfactory beginning in the lizard as a thickening of the epiblast, which is gradually transfromed into a round depression.

Keibel (1893) deduced no conclusions from the study of a series of Anguis fragilis but agreed with those of Born, and admits that in important points there is analogy with mammals.

Voeltzkow describes, in the Madagascar crocodile, the formation of an olfactory cavity, as in the saurians. The differences lie mainly in the development of the palate. The palate prolongations are formed of large laminae which come in contact through the middle portion of their length; the palatal laminae and the pterygoid, behind, limit a long nasopharyngeal canal.

Meek (1893) describes, in the early stages of the Crocodilus porosus, the nasal cavity and its diverticula, particularly a closed groove of the internal wall, which is a vestige of the organ of Jacobson.

Sluiter (1892) and Röse (1893) in a series of young embryos of the crocodile, studied a cul-de-sac of the postero-inferior extremity of the nasal cavity, which they considered as the organ of Jacobson.

Seydel found the olfactory beginning in the turtle (Chrysemys picta), as a fossette, which is deepened and limited by nasal buds which are fused as in the lizard. It forms on the median wall a groove covered with olfactory cells, and separated by a projection of indifferent epithelium from the sensory epithelium situated above. Seydel compares it to the inferior cul-de-sac of Amphibia, and considers it the organ of Jacobson.

Karl Peter (1900), studying the development of the olfactory organ of the lizard, shows the part which should be accorded to the corrugation of the ectoderm and the predominant role played in the active development of the olfactory thickening by multiplication of the cells. The organ of Jacobson is thus established by the intrinsic activity of an invagination localized on a limited portion of the median wall of the nasal sac. In later works, Peter (1902) was concerned with the ectodermic thickening of the anterior neuropore and concluded that it has no relation with the paired lateral olfactory outlines.

Beecker (1903) studied the development of the nasal region in several reptiles: Platydactylus guttatus, Tropidonotus natrix and Lacerta agilis. He observed that the nasal canal was divided into the vestibule and the zone of the turbinals. The nasal sac and choanal canal are largely developed transversely and compressed dorso-ventrally. The choanal canal has a horizontal and a descending branch. The horizontal branch forms an internal lateral pocket; the descending branch has a small angular pocket directed obliquely upwards.

The organ of Jacobson opens into the oral extremity of the choanal groove. The true turbinal of reptiles originates from the lateral wall of the principal portion.

DESCRIPTION OF THE STAGES. TROPIDONOTUS NATRIX, 4 *cm. in total length,* the embryo being unrolled (Fig. 35). This is the only stage which we have been able to examine; we have studied it in transverse sections.

A depression of the lateral wall of the head gives access to the olfactory cavity; this is entirely filled in its anterior portion with a cellular mass, composed of polyhedral or round cells with a large nucleus; this is the vestibular region. Passing to the posterior portion, a lumen is encountered which pushes the cells towards the periphery, in the form of an epithelial wall. The dimensions of the cavity are increased as we pass from before backwards; an enlarged dorsal region and an elongated ventral portion may be recognized under the form of a fissure. The epithelium differs in these two zones. In the superior portion it is provided with a superficial layer of cylindrical cells, while in the inferior part it is much thinner

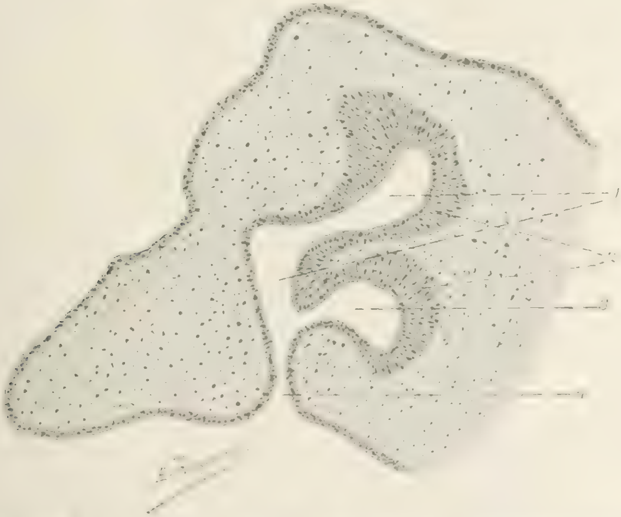

Fig. 35—X 60. Adder, 4 cm. in total length (transverse section of the nasal cavity and the organ of Jacobson; right side). 1. Nasal cavity; 2. Sensory epithelium; 3. Organ of Jacobson; 4. Choana.

and is formed of round cells (Fig. 35). The two nasal cavities approach one another, and the intercalated mesenchyme forms a septum, larger below on account of the obliquity which each cavity attains from above downward and from within outward.

At a distance of 280 mikra from the anterior extremity of the cavity, and 428 below the nasal roof, the internal wall sends out a diverticulum which sinks into the septum, constituting the organ of Jacobson (Fig. 35). It communicates with the nasal cavity by an antero-posterior extent of 60 mikra. It is prolonged longitudinally in front of and behind its union with the olfactory organ, 120 mikra anteriorly and 130 posteriorly; its total length is 310 mikra. Its anterior and posterior extremities are solid cellular masses. The entire anterior segment is greater in width than in height; its dorsal wall is very thick (114 mikra), while the ventral wall is only 21. The lumen has the form of a crescent, with concavity inferior, on account of the convex ridge made by the ventral wall on the interior of the cavity. The dorsal wall presents a superficial layer of greatly elongated cells having the characteristics of sensory cells. The ventral wall is provided only with cubical or round cells. The posterior segment of the organ of Jacobson is a cylindrical canal with walls of uniform thickness and covered throughout with sensory epithelium.

At the level at which the ventral region of the cavity forms the evagination of Jacobson, its vertical extent increases and it attains the buccal wall so as to form the choana.

The external wall of the nasal cavity is strongly convex and corresponds to a concavity of the internal wall. In the portion situated behind the choana, the convexity of the external wall is of less extent vertically; it is localized in the middle portion of the wall and forms a very slight ridge, representing the outline of the turbinal.

The posterior extremity of the cavity forms a cul-de-sac, and the wall is prolonged posteriorly in the form of a solid epithelial mass.

The sections including the posterior extremity of the organ of Jacobson and of the nasal cavity pass through the olfactory bulbs and show the branches of the olfactory nerve divided into two groups, one for each of these organs. The disposition of the olfactory apparatus in the viper is the same as that in the adder.

Anguis Fragilis, 25 *mm. long* (Figs. 36 and 37). The general form of the cavity is similar to that of the adder. It is long vertically, in transverse sections, and oblique inferiorly and externally. The superior portion, which is spacious, is covered with very thick epithelium; the ventral portion, which is narrow, is covered with an indifferent, thinner epithelium.

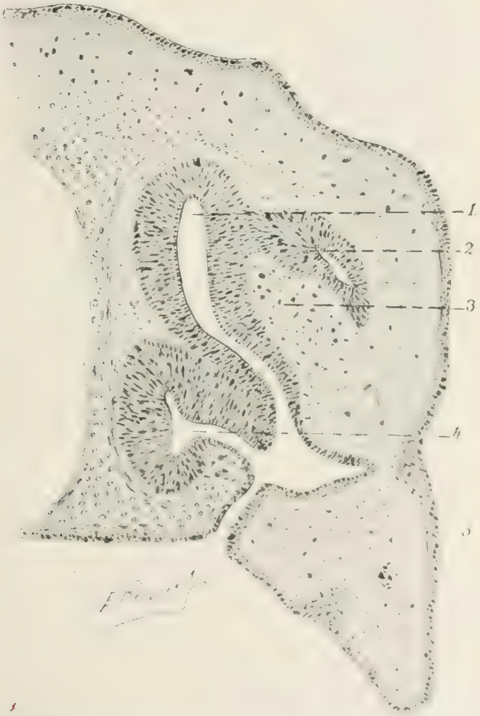

Fig. 36—X 68.5. Blind-worm, 25 mm. total length (transverse section passing through the nasal cavity and the organ of Jacobson, showing an epithelial bud of the external wall sinking into the mesenchyme; left side). 1. Nasal cavity; 2. Epithelial bud; 3. Mesoderm of the turbinal; 4. Organ of Jacobson; 5. Choana.

A central cartilaginous lamina begins to be differentiated in the septum. Between this septum and the inferior extremity of the nasal cavity, is the organ of Jacobson, a solid epithelial mass anteriorly and posteriorly (Fig. 37) and a cylindrical canal in the remaining portion (Fig. 36). The communication with the nasal cavity is placed, as in the adder, on the internal wall of the choana. The cylindrical cells begin to differentiate at the level of the dorsal wall of the organ of Jacobson, which is composed of very thick epthelium. The thin ventral wall is raised slightly towards the cavity (Fig. 36).

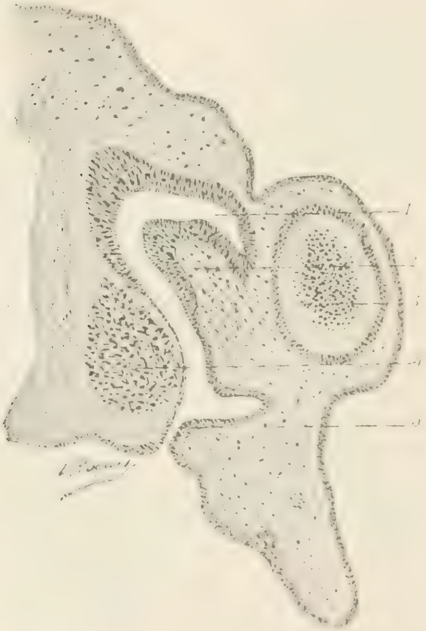

Fig. 37—X 60. Blind-worm, 25 mm. long (transverse section passing behind that presented in Fig. 36; the turbinal is limited above by a fissure which has replaced the epithelial bud of the preceding section. The organ of Jacobson is represented only by a cellular mass; left side). 1. Superior fissure; 2. Turbinal; 3. Eye; 4. Organ of Jacobson; 5. Choana.

A turbinal, already well developed, is found on the external wall of the olfactory cavity. It is possible here to see distinctly how a turbinal is formed (Figs. 36 and 37). The external wall presents a convexity limited above by the nasal lumen, which penetrates into it in the form of a fissure. This increases and is directed outward and then downwards, thus causing a ridge on the external wall—a mass of mesenchyme covered by an epithelial layer projecting into the cavity. The base of this mass has a height of 250 mikra and a transverse extent of 285.

The fissuration is effected in an epithelial mass, resulting in a budding of the external wall (Fig. 36). The cells which form these buds are round, packed closely together, having a distinct border, a finely granular protoplasm staining well with carmine, and a deep nucleus, often seen dividing. The beds are not separated from the mesenchyme by a limiting membrane; their borders are indicated only by peripheral elements arranged in a regular layer. The nasal lumen penetrates into the mass, destroys the cells and arranges them in two epithelial layers, which border then on one fissure (Fig. 37).

The nasal cavity terminates in a cul-de-sac, behind the posterior extremity of the organ of Jacobson. Nerve fibres are seen passing from the olfactory bulb into the two organs, those of the organ of Jacobson being the most anterior.

Three centimeters. The nasal cavity and the organ of Jacobson increase in length, and their lumen is of greater extent. The turbinal is much more evident, a round ridge with thick pedicle. The nasal epithelium is very thick on the superior border of the turbinal and upon the walls throughout their extent, subjacent to the latter.

All portions with thick epithelium have a superficial layer of cylindrical cells. The inferior border of the septum is enlarged transversely; the inferior portion of the internal wall of the choanal fissure takes part in the buccal roof, thus the organ of Jacobson, completely separated from the nasal cavity is seen opening directly into the mouth.

Four centimeters (Figs. 38 and 39). The nasal cavity is large and of elliptical form on transverse sections. It has a floor slightly concave in place of being elongated to a point towards the buccal roof as in the preceding stages. The turbinal is greatly developed, beginning 340 mikra from the anterior extremity of the cavity and having a length of 360 mikra. Its anterior extremity is a slightly elevated ridge with a large base, but its height increases little by little and its pedicle is contracted. The thickness of the pedicle towards the middle portion is 107 mikra; the height of the turbinal (distance from the base of the pedicle to the free border) measures 378 mikra

(Fig. 38). It becomes thin and low gradually towards the posterior extremity.

The fissure which circumscribes it ventrally sinks into the axial mesenchyme at first from below upward and then from without inward. The surface of the turbinal is thus defined, the free border is displaced and the organ has the appearance of being rolled on its axis.

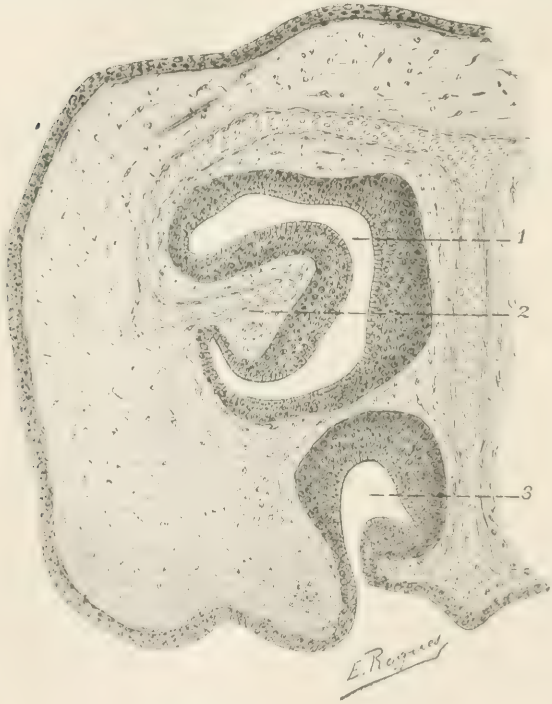

Fig. 38—X 68.5. Blind-worm, 4 cm. long (transverse section passing through the nasal cavity in which a pedunculated turbinal projects and through the organ of Jacobson opened directly into buccal cavity; right side). 1. Nasal cavity; 2. Turbinal; 3. Organ of Jacobson.

The nasal cavity is surrounded by a cartilaginous capsule, still in fair way of development, at the level of the inferior wall. The external wall sends out a lamina which penetrates into the turbinal and lies in the middle of the mesenchyme which it follows up to the level of the free border, being subjected to beginning rolling.

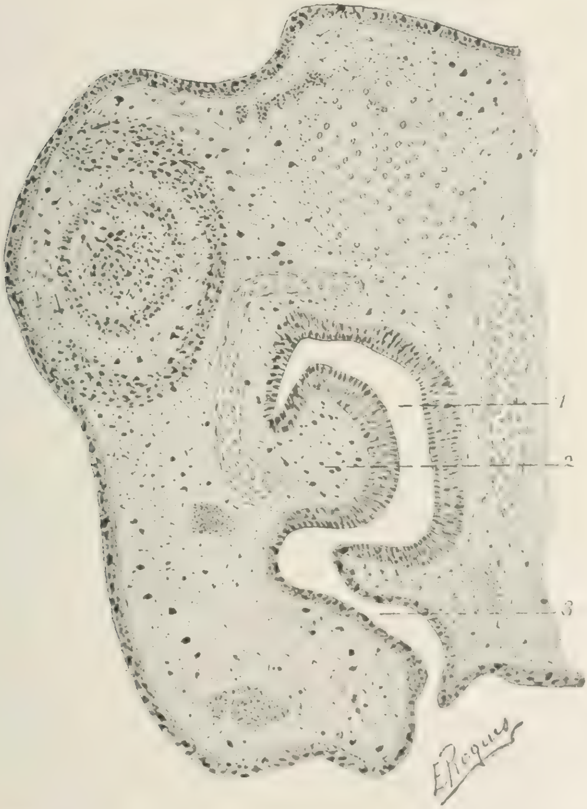

Fig. 39—X 68.5. Blind-worm, 4 cm. long (transverse section, posterior to that represented in Fig. 38, showing the choana which has acquired a definite arrangement; right side). 1. Nasal cavity; 2. Turbinal; 3. Choana.

The organ or Jacobson has a length of 370 mikra and the lumen occupies it almost entirely. It communicates with the buccal cavity, 220 mikra from its anterior extremity by a small fissure which arises from the internal border of its floor (Fig.

38). It presents throughout its extent a thick dorsal wall covered with sensory epithelium and a thin ventral wall, projecting into the cavity, formed of cubical or polyhedral cells.

The posterior extremity of the organ of Jacobson appears at the level of the choana. This last is a narrow canal directed obliquely from above downward, and from without inwards, arising at the infero-external angle of the nasal cavity (Fig. 39). The choanal canal and the nasal region subjacent to the turbinal are covered with flat epithelium; all the other regions, including the turbinal, are provided with thick epithelium, the superficial layer of which has cylindrical elements. The organ of Jacobson is in relation with a cartilaginous groove, opened externally, which covers its internal and inferior walls; this is independent of the nasal septum.

Seven centimeters. (Embryo has two small posterior members.) The nasal cavity is large at its anterior extremity; it opens externally through the middle of the external wall. The region of the opening is covered with pavement epithelium on the inferior wall and the parts adjoining the external and internal walls, while the other portions are covered with cylindrical epithelium. The relations of the nasal cavity and of the organ of Jacobson are as in the adult. The bony skeleton is already well developed; external to the cartilaginous capsule are seen the vomer, maxillary and nasal and, towards the middle portion of the external wall, the external nasal gland. The turbinal is clearly pedunculated and it describes a half turn of enrolling.

LACERTA MURALIS. The olfactory fossette in a 6 mm. embryo is deep and opened below. The primitive palate is not formed at this stage. The organ of Jacobson opens on the internal wall of the fossette near its inferior extremity. It has for a certain distance the form of a groove, then forms a cylindrical tube isolated from the nasal wall.

At the stage of 7.5 mm., the ridge of the external wall is developed, being formed, as in the blind-worm, by fissuration of a solid epithelial mass; the internal and external nasal cushions are fused for a certain extent. The opened portion, situated behind the primitive palate, receives the end of the canal of Jacobson. The 10 mm. embryo already presents the characteristics of the adult. The cartilaginous skeleton is well differentiated; the ridge which becomes the turbinal now occupies the superior surface, and forms an enormous prominence in the olfactory cavity, which is reduced to the two fissures limiting this ridge. The organ of Jacobson is prolonged in front of the anterior extremity of the olfactory cavity and opens directly into the buccal cavity.

BEGINNING OF THE OLFACTORY OUTLINE. Born, in an embryo of Lacerta agilis with ten primordial segments, observed a zone of ectoderm between the anterior neuropore and the primitive ocular cavity, in which the cells take on a cylindrical form; this is the olfactory plate.

Peter studied the evolution of this olfactory plate in the lizard, and accorded to the multiplication of the cells constituting it the most active role in the growth of the organ. He found the olfactory fields well marked in the stage of eleven primordial segments. He found on the ventral wall of the anterior neuropore, in the stage of sixteen primordial segments, an ectodermic thickening analagous to that described by Kupffer, but it had none of the characteristics of the sensory plakode and never was in relation with the paired olfactory outlines.

EVOLUTION OF THE OLFACTORY ORGAN. The olfactory fossette resulting from the invagination of the corresponding ectodermic thickening, grows particularly by the mitotic activity of the cells constituting this outline, as was well noted by Peter (1902). The neighboring, indifferent epithelium forms only the bordering portions. Rathke (1838) and Born (1879) described at length the ultimate changes of these portions.

The thick postero-superior border is prolonged, in the form of a curtain, anteriorly and inferiorly into the area of the nasal depression. The free border of this fragment (nasal roof of Rathke) is entirely straight at first, then advances further at its middle portion and is prolonged as a rounded ridge.

At a period at which the nasal sac is still largely open (Lacerta agilis with 47 primordial segments), Born observed the appearance of a groove indicating the organ of Jacobson, from an active depression of the ventral extremity of the median wall of the nasal sac.

The space between the two nasal fossae forms the frontal bud of Rathke and each of its parts forms the internal nasal bud of Koelliker. The external border of the fossette is formed by the external nasal bud, which a groove (lachrymo-nasal) separates from the superior maxillary bud. Fusion of the nasal buds caused at first by the crowding together of the epithelium, then by the union of the two subjacent masses of mesenchyme, separates the nasal groove into two orifices. This fusion is effected in the adder with a head length of 4 mm. The external orifice, in the form of a fissure, is placed upon the plane of the face and the posterior orifice of the choana is situated on the palatal plane.

The bridge of fusion which forms the primitive palate grows, the palatal prolongations of the superior maxillary are united with the nasal septum, and the choanae are displaced backward. We have observed that the inferior part of the septum which divides the choanae from one another grows transversely in such a manner as to separate them. As a consequence of this growth, which causes a transverse enlargement, the orifice of the canal of Jacobson, which opens on the internal wall of the choana, is carried along the palatal surface, and the definite opening of the choana is finally external to the communication between the canal of Jacobson and the buccal cavity. The two organs are then independent of one another; this process is effected in the blind-worm at the stage of 4 cm. of total length.

The organ of Jacobson does not remain here in the state of a groove communicating throughout its length with the nasal cavity as in the Anura: it is transformed into an isolated, well-defined canal, entirely independent of the olfactory cavity.

Two interesting points are found in the nasal cavity: the formation by growth antero-posteriorly of a vestibular region, and the delimitation of a ridge on the external wall in the form of a turbinal. While the turbinal is a simple ridge in the adder, in the blind-worm it is comparable to those of the mammals.

We have seen how it is established by the growth of the fissure of the nasal lumen. Some epithelial buds begin to isolate a region of the mesenchyme, then the fissure penetrates into the bud and the mesenchymatous mass, covered by the epithelium of the cavity and of that which is organized along the fissure, forms a free ridge in the nasal cavity, simply united to the external wall by a base, more or less large, forming the pedicle of the turbinal.

The round, embryonic cells, which constitute the walls of the nasal cavity, are differentiated into cylindrical cells at the level of the nasal roof at the beginning of development; their territory is already large in the blind-worm of 2.5 cm.

The differentiation takes place on the internal wall and the turbinal; the region, subjacent to the turbinal remains covered with indifferent epithelium. The sensory cells in the organ of Jacobson, limited to the dorsal wall, are completely differentiated at the stage of 2.5 cm.

The lateral nasal gland, of which Born found the beginning in the form of an epithelial bud on the external wall, exists in our sections of the blind-worm of 7 cm. It is formed by a group of culs-de-sac, situated external to the capsule, near the middle part of the external wall.

In the Crocodilia, according to Voeltzkow, the development is analogous to that of the saurophidians. According to Meek (1863), in the 5 mm. stage of Crocodilus porosus, the nasal sac is completely formed and the anterior and posterior nasal orifices approach very closely to one another. A depression of the frontal wall represents the origin of the organ of Jacobson. At the stage of 7 mm. an evagination corresponding to the lachrymal canal is the beginning of a simple accessory cavity of the nose. The invagination representing the canal of Jacobson is absent in specimens of 7.75 mm. in length. Sluiter (1892) and Röse (1893) found an outline of the organ of Jacobson always present in their investigations. Seydel and Voeltzkow gives but slight indication of it in the chelonians. The organ of Jacobson, according to Seydel, is represented by a groove on the median wall, while Mihalkovics sees this organ in a canal which opens on the septum and has glands in its blind extremity.

ABSTRACTS FROM CURRENT OTOLOGIC, PHINOLOGIC AND LARYNGOLOGIC LITERATURE.

I.—EAR.

A Case of Purulent Sinus Thrombosis with Opening of the Middle-Ear and Preservation of the Ossicles.

G. Braat (*Tydschr. v. Geneesk.,* Feb. 3, 1906) treated a 25-year-old car conductor, who had suffered from youth from a purulent bad-smelling secretion of the right ear, slighter during the last ten years. In August, 1902, he was taken with earache lasting a few days, with vomiting for which he took to his bed. When he attempted to get up he was taken with chills and dizziness, and fell. Pain and swelling of the right sternoclavicular joint appeared, and a bad-smelling secretion appeared in the right ear, of moderate quantity. He suffered constantly with numbness. Braat was consulted three weeks after the fall. He found, on September 7th, pain and swelling of the sternoclavicular articulation. In the right ear there was bad-smelling, bloody muco-pus. The drum had a perforation posteriorly with thickened margins; beyond, it was sound; the malleus was visible. There was no swelling in the canal or behind the ear. There was some sensitiveness on pressure over the mastoid fossa, anterior and posterior part of the process and on a spot 2 cm. behind the process. There was painful swelling of lymph nodes behind the jaw and under the sterno-cleido-mastoid muscle. Temperature and pulse normal for two days. Up to the time of the operation, the sensitiveness was more and more concentrated on one spot 2 cm. behind the mastoid process, although it became less; the lymph nodes became painless and smaller. Pain appeared in the forehead; in the last few days pulse and temperature remained normal. Internal organs normal; no swelling of the spleen. Acoustical acuity right ear for speech at 5 m., whisper 0.5-1.5 m.; left ear normal. Operation of September 16: incision 1 cm. behind the auricle; periosteum very firmly attached to the bone; dura soon laid bare; bone sclerotic; mastoid cells are invisible; the antrum lies very deep and has thickened mucous membrane with granulations and little pus. A probe passes at the posterior wall into a cavity with soft walls. While laying the sinus transversus bare, yellow pus escapes from behind the antrum out of the sinus. The wound is enlarged, the entire sinus laid bare, cut open, the abscess scraped out and tamponed with small pieces of gauze; likewise the mastoid wound and external canal. Vomiting ceased. Two days later the dressing was changed on account of amount of secretion; the gauze was retained in the sinus and antrum and was changed four days later. The sinus closed quickly. October 1st, operation continued: the bony posterior wall of the external canal was removed, while the ossicles were retained; operation completed with Stacke's plastic. First change of dressing October 7th. Patient left for home October 10th; entirely healed. December 28, 1902, with speech at 5 m. and whisper at 0.1 m. A little pus was noticed January 27, 1903, at the anterior part of the spur; the place was touched with lactic acid. On March 8th and April 12th there was again a trace of pus and a small crust has formed since from time to time at that spot.

Observation October, 1905: drum with a chalk patch before the malleus, large perforation behind it, the long arm of the incus visible; from the drum a membrane goes over the attic region and posteriorly over the former surface of the wound. Speech at 5 m.; whisper at 1 m. Tuning fork tests for C2: Weber to right;. Rinné right negative; Schwabach neither lengthened nor shortened. Braat considers the preservation of the ossicles very important with regard to the auditory acuity.

Posthumus Meyes praised the result, but believes that the auditory perception took place here chiefly through the round window, which he finds closed by a very thin membrane.

Braat denied the presence of this membrane.

Schutter finds the result quite good; however, such operating should not be followed. The preservation of the ossicles does not ameliorate the hearing; their relationship becomes abnormal, their attachments partly lost, and therefore the operation is less radical and the chance of a cure smaller, although the case demonstrated had a good result.

Quix agrees with the foregoing speaker. The drum with the loose ossicles will interfere with the hearing. The communicated auditory acuity is not very good and would perhaps be better if the ossicles were removed.

Braat replied that the ossicles can be easily removed under narcosis; he did not think that the functional results would be better then.

Blaauw.

A Case of Probable Inflammation of the Basis Cranii, Beginning as an Acute Mastoiditis.

H. Braat (*Tydschr. v. Geneesk.,* Feb. 3, 1906) saw his patient eight days after she was awakened with a pulsating pain behind the left ear; two days later, the left upper eyelid became swollen, closing the eye; after a few days this swelling disappeared. Braat found the left auricle projecting from the head, distinctly different from the right side; the mastoid process was slightly swollen, red and very sensitive on pressure. The drum membrane was entirely normal, no swelling or redness of the posterior wall of the canal. Hearing normal; also the tuning fork tests. Temperature 37.8°-38.1° C. Rest in bed and ice on the mastoid process were ordered. Two days later the condition had not improved, mastoid pain increased with much headache; temperature 37.9°-38.5° C. Patient was taken to the hospital; she was very moody, complained of severe pain behind the ear; the upper eyelid was again swollen, the left eye deviated to the left, but could be moved well in all directions; pupillary reflexes on both sides normal; the entire head had a slight caput obstipum position to the right; speech was slightly impaired; the left side of the tongue was very swollen; when she showed the tongue it deviated strongly to the right; she could not move it to the left; the uvula was turned somewhat to the right. Sensation for sweet, salt, sour and bitter was possible over the entire tongue; sensibility everywhere normal. She vomited a few times. The left cervical region was not markedly painful, the internal jugular was not palpable; the entire region was hyperesthetic and hypalgesic. Urine frequently examined, normal; also fundi oculi always normal; laryngoscopic image normal.

It was difficult to make a diagnosis; the complaints were chiefly localized in the mastoid region with pains radiating in the parietal region. The intact middle ear, the increasing and diminishing swelling of the left eyelid and, at the end, the swelling of the left half of the tongue which receded again for the most part after a few days, while the deviation to the right remained, made it probable that we had to deal with a process in the mastoid not originating in the middle ear cavity, to which a periphlebitis or phlebitis was added; on account of the rise of temperature a perisinuous abscess was expected.

Nineteen days after removal to the hospital, Braat operated; after incising the skin the subcutaneous tissue was found infiltrated and a few swollen glands were found; the bone was not injected, the mastoid cells were entirely normal; he did not continue his operation to the antrum; posteriorly no infiltrated bony tissue nor pus was found, so the operation was completed. Ten days later the wound was closed, the pain was decidedly less and the nausea had disappeared. She left the hospital, but her condition was not improved. The swelling of the left side of the tongue and of the left upper eyelid returned at intervals. The headache returned with increased intensity and she complained more frequently of pains in the occiput. This condition continued till about for weeks ago when the pain in the ear became worse and a little later a little pus was discharged. Speaker being absent the patient was taken care of by Dr. Ter Kuile. Shortly after, Braat found a small perforation in the posterior lower quadrant with little or no secretion; after enlargement of the perforation no pus discharged, nor after Politzerization.

At present the tongue is directed still to the right, although she can bring it more to the left corner of the mouth; there is no more swelling of the upper eyelid and the position of the left eye is normal; temperature about 38° C. The pulse is mainly small and frequent, 110-140 and never slow. In consultation with Prof. Pel, Braat considers it most probable that there is an inflammatory process at the base of the brain in which the hypoglossus nerve and the right external ramus of the left vago accessorius are involved; he can not decide if there is an extradural abscess or a tuberculous process; in the latter case it should be assumed that there are a few tubercles at the base of the brain which press or irritate the nerves. Braat did not consider the indication present for puncture of the sinus, as the bone near the sinus was normal. Zaalberg considers this argument insufficient and would perform puncture.

Delsaux asked if the general sensibility had been examined, and mentions the case of a lady who was operated for pains in the mastoid which disappeared although the mastoid was normal; later patient became very sick, weak and an unilateral anesthesia was found. Braat's patient was examined by a nerve specialist, who found no anomalies.

Blaauw.

The Surgical Treatment of Meningitis of Otitic Origin.

ALEXANDER (*Archiv. Internationales de Laryngologie,* 1905, p. 711). The last few years have witnessed great progress in the surgery of suppurative affections of the labyrinth. A like advance has not occurred in the results of treatment of otitic meningitis. This, in part, can be explained by the fact that in most complications of otitis suppurativa, meningitis has caused the death.

Nevertheless, today most otologists believe in the privilege of intervention, and cases of purulent meningitis, even well advanced, have under favorable conditions been cured by surgical interference. Such intervention consists in

1. Immediate operation upon the ear and the removal, as thoroughly as possible, of the diseased focus.
2. Exposure of the dura mater.
3. Incision and drainage of the intradural cavity.
4. Tamponing and aspiration of the fluid through the incision in the dura.
5. Lumbar puncture.

Meningitis may be divided anatomically into

1. Purulent meningitis.
2. Tubercular meningitis.
3. Serous meningitis.

Of these, from a therapeutic standpoint, we can hope for nothing in tubercular meningitis. Until recently the same was true of purulent meningitis; now we have three cases reported cured by operation (one by MacEwen and two by Gradenigo). The proof of their purulent nature was furnished by the lumbar puncture. Hinsberg reports ten cases and four cases were seen in Politzer's clinic, where pus was evacuated at the operation.

Internal pachymeningitis is also amenable to operation if taken sufficiently early.

Serous meningitis is, however, where our greatest hope of success lies. A considerable number of cures have been reported. Exact proof of the conditions present in such cases the author admits is lacking. Cases which did not get well, however, showed purulent deposits at the autopsy, while those which recovered showed a congestion and tension of the dura and a normal fluid. Much depends upon the virulence of the particular micro-organism. If this could be determined by inoculation or otherwise we could form a fair idea as to the prognosis. Up to the present time this has not been attempted. Of prime importance is the discovery of the exact focus in the ear from which the infection proceeded. This is often difficult or impossible. It is advised, accordingly, after thorough attention to the ear, to expose the dura of both middle and posterior fossae, if clinical symptoms for localization was wanting. In case the dura is altered, a free incision is demanded and a gauze wick introduced. On the other hand, if no alterations in the dura nor increase in intradural tension can be recognized, it is safe to delay entering the cranial cavity even in the presence of meningeal symptoms.

Alexander's views regarding the value of lumbar puncture and the practice at the Politzer clinic are especially interesting. It would appear that he regards the results of such examination as doubtful and possibly confusing from an operative and even diagnostic standpoint, for it is the rule in the Politzer clinic to consider every case of meningitis operable if the physical condition permits. In other words, pus and microbes in the spinal fluid are not a contraindication to operation. We may be dealing with a case of meningitis which is curable, or it may be a brain abscess which causes the pus in the fluid. This is equally true when the fluid is clear. Here we may have the early stage of a meningitis. As a therapeutic measure it does not offer any promise. Alexander also is inclined to believe better results follow the free incision than from a mere intradural puncture and aspiration.

Incisions from ¾ to 1 centimeter are long enough and will not cause hernia unless an encephalitis and edema of the brain exist. He regards such incisions as free from danger, if practiced under strict aseptic precautions.

Post-Operative Meningitis.

ZERONI (*Archiv. für Ohrenheilkunde*, Vol. 66, page 199). Fatal cases of meningitis following operation for chronic otorrhea, without any previous complication, are becoming only too frequent. Operators have been inclined to regard such results with seeming indifference—dismissing them with the bare statement that the meningitis had been existent already but unrecognized. Such treatment of these tragic accidents tends to discredit otitic surgery with the profession and laity. Acute cases do not fall within this class, for we can never tell in advance how extensive the lesion is. Zeroni believes that the majority of purely chronic cases operated on which are followed by meningitis will show previous suppurative movement of the labyrinth. In his opinion, and that of several other observers, the latent labyrinthitis is made active by the chiseling, and he regards this as a serious objection to the extensive use of this instrument. Macewen has seen meningitis follow the removal of granulation from the middle ear. In confirmation of his views the author gives the histories of 29 cases where the autopsies revealed, without exception, labyrinthine suppuration. The appearance of the meningitis was frequently directly after the operation. In one case it was during the operation that chills and high fever were observed. In 15 of the 29 cases no symptoms of any kind were present.

The results of the pathologic examination show that the labyrinthine disease was not of recent date. It is probable, however, that a decided increase in its intensity followed the operation of the various lesions of the labyrinth. A study of the 29 cases shows an especial danger for post-operative meningitis where there are defects in the labyrinthine windows. Indeed, the existence of a communication between the labyrinth and the operative field in the middle ear is the indirect cause of the meningitis. While chiseling is a potent factor in exciting it, it is not the only one, as is shown by several cases where the chisel was not used.

In a certain number of instances, however, the autopsies revealed no involvement of the labyrinth. The histories of 11 such cases are given. In all but two it was possible to demonstrate the presence of pus centres between the dura and the bone. This, Zeroni believes is the rule where no inner ear disease is present to explain the meningitis. It is true the intact dura offers resistance to the penetration of bacteria, but they can easily enter along the normal passages in the dura, such as that for internal carotid or for the acoustic nerve.

In many of such cases an intermittent meningitis is present, not permitting of a diagnosis. The operation serves to set this into activity, in all probability by allowing fresh bacteria to get in. Further, the effect of the resulting blood clot and tampon is to shut off the drainage to surface which had previously existed.

In general, the common danger in all cases rests in the fact that deep, unapproachable foci of pus are not discovered and so not drained. This is true even in the labyrinth cases where fistulae exist, for the drainage is entirely insufficient. In the author's opinion the avoidance of this most unpleasant complication is to be found in refraining from all operation where labyrinthine disease is suspected.

Unfortunately the diagnosis of such disease is often impossible. Deafness of a pronounced degree is not always present and vertigo is frequently met in chronic middle ear suppuration. In the case of deep-seated areas of pus the outlook is better, for here, instead of avoiding all interference, we can hope to find them and remove the disease. Caution is, however, to be continually observed in all manipulations over or on the inner wall of the middle ear. *Harris.*

Otologic Report from Prof. Gerber Policlinic and Private Practice, for Year 1904.

M. MAGNUS (*Arch. f. Ohrenh.*, Vol. 67, H. 1, p. 55).

Total number of patients 4,530.

Diseases of ears	2,027
Diseases of nose and naso-pharynx	2,515
Diseases of mouth and pharynx	1,881
Diseases of larynx and throat	444
Total	6,867
Operations on ear	301
Operations on nose	741
Operations on sinuses	56
Operations on mouth and pharynx	352
Operations on larynx and throat	45
Total	1,495
Diseases of auricle	80
Diseases of external meatus	421
Diseases of drum	99
Diseases of middle ear	1,252
Diseases of mastoid	115
Diseases of internal ear	25
Diseases of brain, etc	35
Total	2,027

Removal of foreign bodies	9
Incision of furuncle, etc	39
Paracentesis	121
Wild's incision	1
Operation for deformity	1
Foreign body operations	3
Retroauricular plastic	2
Sinking abscess	1
Schwartze's mastoid	41
Radical (Stacke's)	30
Secondary mastoid (acute)	10
Secondary mastoid (chronic)	8
Bulb laid bare	4
Sinus opened	10
Jugular ligated	7
Labyrinth opened	2
Lumbar puncture	6
Dura incised	4
Puncture cerebellum	2
Total	301

Several cases and all mastoid operations are given in detail.

Some Relations in the Blood-Supply of the Inner Ear which have a Practical Bearing on the Clinical Study of Otology.

SHAMBAUGH, Chicago (*Archives of Otology*, Vol. XXXV, No. 1). The arterial supply is brought to the inner ear through a single vessel, a branch of the basilar artery, which enters the labyrinth along with the auditory nerve through the internal auditory meatus. In a detailed study of the pig, the sheep, and the calf, the author found that a single vessel, the vein of the aquaeductus cochleae, drained the blood from the entire labyrinth. The first two branches of the labyrinthine artery, following the courses of the branches of auditory nerve, supply the entire vestibule and semi-circular canals, with the exception of the saccule. These branches of the labyrinthine artery are terminal vessels, and carry the sole blood-supply to definite areas in the labyrinth. After giving off the vestibular branches, the labyrinthine artery breaks up into a number of branches before it enters the cochlea. These several branches are connected by anastomotic loops before any of the terminal branches are given off to the several parts of the cochlea.

The occurrence of a typical case of Meniere's disease, where there is a profound disturbance in the vestibule and semicircular canals, as evidenced by the occurrence of vertigo and nausea, as well as a profound disturbance of the cochlea, as shown by severe tinnitus and deafness, can be brought about only by some disturbance in the circulation in the entire labyrinth.

Where there is disturbance in the circulation of one or several of the terminal arteries of the labyrinth, there result symptoms which are not the Meniere symptom-complex. For example, the lodging of an embolus in the anterior vestibular artery would result in disturbance limited to the utricle and the horizontal and the superior semi-circular canals. This would cause disturbance of equilibrium without molesting the function of hearing. On the other hand, a disturbance in the circulation, limited to the cochlea without involving the vestibule or semi-circular canals, would produce tinnitus and deafness but not disturbance in equilibrium. Again, an embolus lodging in the terminal artery, which supplies the apical coil of the cochlea, would perhaps cause deafness for the lowest tones without disturbing the upper part of the scale.

Campbell.

Four Temporal Bones of Two Deaf Mutes.

R. Panse (*Archiv. f. Ohrenheilk.* Bd. 64, 2 and 3, S. 118). Two of these have been described before, but have been re-examined in the light of more recent investigestions. His findings were:

First case, left side—Bony ankylosis stapes with oval niche; rarefaction of stapes-vestibular cartilage. Reissner's membrane over the pars basilaris of the cochlea atrophic. Clefts in the lig. spirale. Cortis membrane displaced into the fairly normal sulcus spiralis, and held by a layer of cells. Pars basillaris everywhere degenerated. A few cells in the ganglion spirale; acusticus degenerated. Endarteritis obliterans in art. cochlearis in the acoustic nerve.

R. E. Exudate between neck of hammer and drum, bony ankylosis of posterior stapedial bar. Blood vessels in oval window widened, as on promotory. Anterior and external ampullae distorted. Epithelium colloid degenerated. Nerves atrophied. Thickening of wall of an artery. Endarteritis of vestibular artery. Colloid degeneration of macula utriculi. Dilatation of sacculus and degeneration of the epithelium. Scalae of cochlea widened. Reissner's membrane lengthened. Stria vascularis normal. Lig. spirale rich in blood vessels. Membrana corti malplaced. Organs of Corti seen only as flat mounds of atypical cells. Very few ganglia in canalis spiralis. All other parts normal.

Second case, right ear. Cochlea shows few vessels. Membrane of Reissner ravelled out in vestibular and basal portion, wanting in middle and superior portion. Corti's membrane wanting in frayed portion, otherwise present as mounds or brushes covered with epithelium. In the middle, Corti's organ retained as clumps of colloid and atypical cells. Stria vascularis is similar and very poor in vessel. A few spiral ganglion cells and degenerated nerve fibres.

L. E. Part of Reissner's membrane absent; membrana corti almost entirely present but abnormal in appearance. Organs of Corti an indistinct mass of cells. Stria vascularis colloid degenerated. A few spiral ganglia and acoustic fibres.

Serous Meningitis.

Arnold Knapp (*Archives of Otology,* Vol. XXXV, No. 1). A man aged 18, after an acute otitis media, had tenderness and swelling over the left mastoid process. These symptoms persisted for one week, then abated; but pain over the left side of the head and vomiting persisted.

The pulse rate was slow, he was languid and somewhat stuporous. His sight began to fail. There was marked optic neuritis, R. V.=15/50, L. V.=15/20. Visual fields normal.

On operation the mastoid, antrum and typanum were found to contain swollen but healthy mucous membrane. The ossicles were healthy and the tegmen of tympanum and of antrum showed no defect. Nevertheless, the tegmen tympani was removed from the orifice of the tube back to the superior margin of the petrous pyramid. The dura was healthy and pulsated. The posterior segment of the mastoid process was then removed and the sinus and the dura of the posterior cerebral fossa exposed. At the upper posterior margin of the mastoid process the bone was found discolored and soft. The dura directly above the knee of the sinus was thickened, discolored, bled freely and was covered with apparently old granulations.

A similar area of discolored dura was found over the sinus. The dura above the sinus was incised and perfectly healthy brain exposed. The brain was punctured without result. The sinus was opened and free hemorrhage took place. The bone was then removed back of the sinus to expose the carebellum. The dura there was found perfectly normal; it was incised and this was followed by a gush of cerebro-spinal fluid. This incision was enlarged and kept open to facilitate drainage of the liquor.

The subsequent course showed immediate and continuous improvement. Where the dura was discolored, it had given way as if it were gangrenous and the large defect was filled with infiltrated brain tissue. This was removed with a curette. A small circumscribed cerebral hernia which formed was later covered by a plastic operation. *Campbell.*

Sound Pressure in the Organ of Corti.

ZWAARDEMAKER (*Tydsch. v. Geneesk.*, Feb. 3, 1906) shows a model for the purpose of demonstrating that the sound vibrations in the organ of Corti, after being analyzed by the resonating fibres of the basillar membrane, exercise a sound pressure toward the modiolus. The anatomic demonstration of his interpretation is found in the zona arcuata being unstriped and Corti's fibres failing to have a true joint. The outer hair cells are pressed by the conglomeration of cells of Hensen.

The same mechanism is found in birds. The small bars of the haircells are not needed for this representation, although they can be connected in it (for particulars, *Arch. f. Physiol.*, 1905, Suppl. p. 124).

Struycken asked how he could consider the vibration of the membrane of Corti; it is not clear how a membrane with an elasticity smaller than that of water, could vibrate in water.

Zwaardemaker replied that the theory of Helmholtz-Hensen is assailed by this observation. Helmholtz gives the calculation that it is possible in the Beilagen of his Tonempfindung.

Struycken tried experimentally different membranes to produce vibration through resonance, but did not succeed in observing vibration in the fibers. Helmholtz took small notice in his computation of the external resistance, and just this is of high value in fluids.

Quix considered Zwaardemaker's theory a great advance over the existing one, that the impression may be constant. The entire energy, which is supplied periodically, is transposed into a constant pressure. He observes that a string in water may vibrate very well, wherewith vortices originate.

Struycken stated that a string can do this only when it is rubbed against or has been made to vibrate in some other way; he did not agree that a membrane in water can resonate, unless energy is supplied in a more direct way *Blaauw.*

The Differential Diagnosis Between Cerebellar Abscess and Labyrinthine Suppuration.

Neuman (*Archiv. für Ohrenheilkunde*, Vol. 67, page 191). The symptoms of both affections are admitted by all authorities to be very similar.

Neuritis optica is often present in cerebellar abscess but is not rarely lacking. It is absent usually in labyrinthine disease but occasionally occurs.

Fever may be lacking in both.

Vertigo can be found with or can be lacking in both.

From the study of a large series of cases, Neuman regards nystagmus as the one symptom of value. This never is found in cerebral abscess. Characteristic of it, as associated with cerebellar abscess, is that it increases in intensity as the disease advances. This is never the case in labyrinthine disease. Further, "while in the latter affection the nystagmus is toward the diseased side—later entirely disappearing but persisting toward the sound side—in abscess of the cerebellum the nystagmus is at first toward the healthy ear, but suddenly changes in the other direction. If this symptom is observed cerebellar abscess can be diagnosed with certainty." The author makes the surprising statement that in the majority of cases the two affections occur together.

The report of a number of illustrative cases is given. In each case, approach to the inner ear was affected from behind and the dura with saccus endolymphaticus opened. This allows easy access to the cerebellum and the route of infection from the labyrinth. *Harris.*

Topographic, Anatomic and Clinic Investigations of the Lymph Apparatus of the External and Middle Ear.

A. Most (*Arch. f. Ohrenh.*, Bd. 64, H. 2 and 3, p. 189; also Bd. 64, H. 4). The lymph apparatus of the ear can be divided into that connected with the brain, and lymph vessels in the ordinary sense. The author concerns himself chiefly with the uninvestigated lymphatics of the meatus and tube.

He finds that the auricle possesses a thick network of lymph vessels which become more delicate towards the meatus. The drum has a network a piece for the dermal and membranal layers which anastamose by means of perforating vessels. The vessels of the dermal layer anastamose with those of the meatus, and those of the membranal layer with those of the middle ear. The latter anastomose with those of the tuba, at whose mouth there is another dense network of vessels. There are four groups of nodes belonging to the external ear: (1) The preauricular, (2) the infraauricular, (3) the retroauricular and (4) the deep cervical. The regional nodes belonging to the tube are the glandulae retropharyngeales laterales and the deep cervical nodes. It was impossible experimentally, to discover the nodes belonging to the mucous membrane of the middle ear.

Clinically it has been found that the lymph in otitis media takes two paths: First, that of the external ear, through the drum to the subauricular nodes, or by extension of the inflammation through the mastoid into the subcutaneous lymphatics or the lateral deep cervical nodes. Second, towards the tube and the glandulae retropharyngeales laterales and then to the gl. cervicales profundae laterales. The former occurs chiefly in adults, the latter in children.

Report of the Halle a. S. Royal University Ear Clinic for Year Apr. 1, 1904, to Mar. 31, 1905.

R. Grunert and E. Dallman (*Archiv. für Ohrenheilkunde*, B. 65, H. 1 and 2, S. 55.):

Total number new patients, 2,937.

Total number diseases external ear	744
Total number diseases drum	10
Total number diseases middle ear	2,366
Total number diseases internal ear	571
Total number form of diseases	3,691
Mastoid cases cured	96
No result	1
Under treatment	37
Removed	9
Died	20
	163

Number of ablatio conchae	1
Number of incision meatus	26
Number of paracenteses	180
Number of extrac. polyp	26
Number of mastoids	163
Number of extrac. ossicles	20
Number of tonsillectomies, ca	50
Number of adenoid oper., ca	150
Total	616

Several cases of exceptional interest are reported.

Secondary Herpes Zoster with Ear Disease.

W. Posthumus Meyes (*Tydschrift v. Geneesk.* Feb. 3, 1906) was consulted by a healthy man with rheumatic tendency, who had earache on the previous evening, with shooting pain in the back of his head and elevated temperature. Next day he had a thick sensation in his mouth and complained of deafness, noise and fulness in the left ear. Examination shows otitis media catarrhalis acuta: red swollen drum, whisper at 1 m., while in the mouth at the left side of the raphe, on the hard palate, a sharp drawn broken line of small vesicles filled with clear fluid, surrounded by a red garden, is visible, exactly in the course of the nervus platinus anterior, namely a triangle open posteriorly, the point of which approaches the incisivi. Patient was given sodium salicylate. After 24 hours the condition remained the same. A day later vesicles began to disappear, the pain practically left, the drum showed only a light redness, whisper heard at 3 m. A week later all had returned to the normal.

Meyes thinks this is a case of secondary or symptomatic herpes zoster. The explanation is not easy, as every indication of inflammation in the neighborhood of the Gasserian ganglion failed. Perhaps specific toxic causes (rheumatism, influenza) other than an inflammation of middle ear may influence this ganglion without distinctly observable symptoms.

Blaauw.

The Etiology of Serous Meningo-Encephalitis of Otitic Origin.

Stenger (*Archiv. für Ohrenheilkunde*, Vol. 66, page 144). The diagnosis of endocranial complications of chronic suppurative otitis is yet in much obscurity. The lumbar puncture in recent years has not fulfilled the earlier predictions as to its diagnostic value. The positive findings (cloudiness of the fluid) denoting bacteria can no longer be regarded as certain evidence of a diffuse purulent meningitis. Rather may the bacteria proceed from a local inflammatory area—general purulent meningitis can never get well. To prove the contrary assertion it must be conclusively shown that the results of the lumbar puncture will reveal, beyond doubt, a general purulent meningitis.

Such findings will determine the presence of an inflammatory process inside the cranium, but not its extent or severity. Accordingly, the decision as to surgical intervention is not to be based exclusively on such results. Active meningeal symptoms may exist in a simple mastoiditis without true meningitis. Stenger gives the histories of three cases where the radical operation was performed, which were followed by symptoms of meningitis and all recovered by incision in the dura. All the symptoms were due to intra-meningeal tension and to the accumulation of cerebro-spinal fluid. *Theisen*

A Case of Trigeminus Neuralgia with Affection of the Middle Ear.

DR. A. SIKKEL'S (*Tydschr. v. Geneesk*, Feb. 3, 1906) patient, 39 years old, suffered since March from pain in the right lower jaw, which constantly increased. The attacks, which appeared as true tic, went slowly from the jaw to the cheek, the pharynx, occiput and neck. A molar was removed without result. Neuralgia treatment was without avail. Patient suffered in youth from a running ear. The patient gave the impression of suffering greatly from pain. He stated that he was unable to eat without a sudden severe pain, mostly in the under jaw, radiating sometimes to the ear, but never starting in the ear. This is the picture of trigeminus neuralgia in all its branches. The right ear shows a destroyed drum; only the handle of the malleus, with a rest of the membrane before and behind, is visible. Pus appeared superiorly and posteriorly. During the first days of treatment there was copious secretion. In view of the seriousness of the process and the fruitlessness of other treatment, radical operation was performed, after which the pains disappeared, and so far have not returned. Sikkel thinks that irritation of the ganglion gasseri, originating in the middle ear process, caused the neuralgia.

Blaauw.

The Diagnosis of Syphilis of the Auditory Nerve.

A. ROSENSTEIN'S (*Archiv. für Ohrenheilkunde,* Bd. 65, H. 3 and 4, S. 194) conclusions.

1. Syphilitic disease of auditory nerve is much more frequent than heretofore believed.
2. The most frequent affection is a basal, gummatous meningitis. Less frequent are gummatous affection of the pyramid and periostitic stenosis of internal meatus.
3. Nucleus and root of nerve frequently attacked at same time as nerve itself.
4. Syphilitic paralysis of auditory nerve can be due to nuclear or root affection.
5. Hereditary lues may be due to neuritis acustica as well as primary labyrinthitis.
6. The 8th nerve is less able to withstand syphilis than the 7th.
7. Syphilis of auditory nerve is a very grave condition, and demands careful observation and treatment.
8. Prognosis is good under these conditions.

Symptoms indicative of syphilis of the auditory nerve are not, as a rule, to be distinguished from those due to other processes in the nerve.

Systematic Hearing Exercises for Deafness.

A. C. H. MOLL (*Tydschr. v. Geneesk.,* May 13, 1905) had treated a case of purulent otitis media chronica in a man whose left ear had been deaf for some time. After treatment, whisper could be heard at 1 m., common speech at 8 m. As later, suppuration started anew he had recourse to a homeopathic remedy: tinct. thujae; notwithstanding this the hearing diminished and tinnitus appeared, which increased after repeated instillations. A few days later Prof. Zwaardemaker found the hearing very much reduced. Moll observed patient in the hospital, where he underwent the pilocarpin treatment, which did no good; massage and galvanization were not effective. He now began systematic hearing exercises of Urbantschitsch. The hearing is still defective, but he can now understand ordinary speech at one meter aided by a hearing tube, which he has selected himself; his conversation is better or worse according to the distinctness of the voice and his own more or less calm or nervous condition. The amelioration, where the deafness is the consequence of an affection of the sound perception apparatus, speaks in favor of an increase of the auditory sensitiveness. *Blaauw.*

Infective Sinus Thrombosis.

KERRISON, New York (*Archives of Otology*, Vol. XXXV, No. 1). This paper is a criticism of Richard's article "on the operative treatment of infective sigmoid sinus thrombosis," an abstract of which appeared in the ANNALS OF O. R. & L., Vol. XV, No. 1, page 150.

The author believes (1) that the sinus should be opened only in the presence of symptoms or physical signs pointing fairly definitely to intra-sinus involvements; and (2) that to advise opening the sinus in spite of the absence of symptoms in all cases in which the surgeon suspects the existence of a clot, without any definite statement as to the physical signs justifying such a suspicion, is an inexact and unscientific method of expression which should not find place in otological literature.

In cases of mastoiditis with symptoms characteristic of sinus thrombosis, the author lays bare the sinus, removing every vestige of diseased bone, leaves undisturbed the overlying granulations and awaits developments. He claims the great majority of cases recover without further operative intervention. *Campbell.*

The Auscultation of the Middle Ear.

W. UFFENORDE (*Arch. f. Ohrenh.*, Vol. 66, H. 1 and 2, p. 1) concludes:

1. No diagnosis can be made by means of the distinctions of the sound, as to whether it is due to tubal or middle ear condition, as it may meet an obstruction which may absorb or reflect sound waves.

2. The blowing noise comes from the end of the catheter and the tube, the middle ear acting as a resonator.

3. No conclusion as to the consistency of the secretion can be drawn from the musical character of the sound.

4. Rales from the middle ear have a deeper note, and a secondary sound due to the secretion falling backwards. The tubal rales are higher and fewer.

5. If no auscultation sound is heard in a moist catarrh, the obstruction is usually in the tube.

6. Under ordinary conditions most of the secretion leaves the middle ear via the Eustachian tube.

7. A whistling noise indicates secretion but gives no clew as to the size of the perforation.

A Case of Acute Middle Ear Suppuration, Complicated by Labyrinthine Fistula and Paralysis of the Abducens Nerve.

Hastings, Los Angeles (*Archives of Otology*, Vol. XXXV, No. 1.) A man aged 22, whose mastoid had been opened on account of an acute mastoiditis, continued to have increasing pain and discharge from the ear. There was dizziness, vertigo and diplopia, due to paralysis of the abducens nerve on the affected side. Temperature and pulse were practically normal. Twenty-three days after the primary operation the radical operation was undertaken. On removing pus and granulations from the tympanum, pus could be seen coming from the inner tympanic wall, in the recess of the oval window. The fistula was probed and found to lead inward, apparently into the vestibule to a depth of about ½ cm., before bony resistance was met with. The opening was enlarged and the fistula swabbed with a solution of bichloride of mercury. There was no necrosis of any other part of the tympanum. The pain subsided after this operation. The paralysis and diplopia gradually disappeared and the discharge ceased within a week. Tinnitus persisted and the hearing in that ear was practically gone. *Campbell.*

The Diagnosis of Intracranial Complications of Suppurative Ear Disease.

John F. Barnhill (*Journal American Medical Association*, November 11, 1905) thinks that, in cases of brain abscess, hemicrania is seldom or never wanting, appearing as an early symptom and persisting throughout. It is seldom complained of over the site of the abscess, and may be quite a distance from it, as in one of his cases, in whom the pain was persistent and severe over the region of the frontal sinus of the same side of the head.

Persistent headache in connection with a foul-smelling ear, in which necrotic bone, granulations and cholesteatoma is discovered to be present, should not fail to cause the medical attendant to think of brain abscess. Irritable disposition of the individual has also good diagnostic value. Vomiting is almost certain to be noticed at some time during the progress of the disease. Temperature is usually subnormal and the pulse from 60 to 45. While a chill may occur at some time during the disease, it is certainly not to be compared in diagnostic value to that of sinus thrombosis. *Richards.*

Operative Technic and After-Treatment of Mastoiditis with Epidural Complications.

W. SOHIER BRYANT (*Medical Record,* March 31, 1906) thinks the best results in the way of after-treatment in cases requiring radical operation are obtained by the use of the front bent gouge instead of chisels or other gouges requiring the mallet, as it allows the convalescence to begin more quickly. By closing the mastoid wound and allowing it to collapse and partially fill with blood clot to permit union by first intention, the convalescence is shortened. By allowing the anterior flap of the wound holding the pinna to fall inward and backward and lie on the posterior and inner wall of the wound, the post-aural cosmetic effect is improved. He avoids the packing which causes the formation of a large cavity, requiring a long time to granulate up. He does not regard the exposure of the dura mater as a complication of special importance.

Richards.

Sinus Thrombosis—A Report of Two Cases, with Masked Symptoms.

HILL HASTINGS (*Journal American Medical Association,* November 18, 1905). In Case 1 the sinus thrombosis was a sequela of typhoid fever. The mastoid operation was first done and the sinus examined, and found apparently normal. Temperature pursuing the septic course, the sinus was again examined and opened, when it was found thrombosed at the knee. It was then resected, together with the internal jugular vein. The septic temperature, however, continued and death occurred six days after the resection.

In Case 2 mastoid operation was done by reason of a vague malarial history following an acute aural suppuration, and the sinus was examined in order to be assured that it was normal. It was found, however, to be partly broken down, so curetted above and below until free bleeding took place, recovery resulting.

Richards.

Peculiar Symptoms Following a Radical Operation.

GEORGE F. COTT (*Journal American Medical Association,* November 11, 1905). In this case, following the operation, the patient had a varying temperature, with fullness of the central retinal veins in both eyes, and preparations were made to operate for sinus phlebitis, that diagnosis having been made. Temperature falling a little each day, operation was postponed, and recovery eventually took place, although there were at intervals slight chills and a temperature varying from 100 to 104.

It is possible that complete thrombosis without general infection took place, and it would seem to the reviewer that there must be many cases in which this takes place, and that the results may be as prompt and quite as good as in some of the cases in which the operation for sinus thrombosis is performed. *Richards.*

The Danger of Operation on the Bulbus—Formation of an Encephalocele.

K. Grunert (*Archiv. f. Ohrenheilkunde,* Bd. 64, H. 2 and 3, S. 97). In the course of a case operated on for thrombus of sigmoid sinus, there developed a prolapse of the brain, which gradually increased in size and through a fistula gave exit to large amounts of cerebro-spinal fluid. This gradually decreased under pressure bandage and cauterization with silver nitrate, and finally became almost covered with epidermis. At the time of writing, prolapse had not entirely disappeared. The liquor cerebralis came from the ventricles of the brain. In spite of its large amount, there was no infection. The prolapse was probably due to toxins acting at a distance from site of their origin. Where this site was it is impossible to tell, as patient did not die.

Examination of the Ears of Railway Employees.

R. Sach (*Archiv. für Ohrenheilkunde,* Bd. 65, H. 1 and 2, S. 7) results:

No.	Office.	Normal.	Disturbance. Slight	Disturbance. Severe
155	Trainmen	99—60%	42—32%	14— 8%
115	Firemen	73—60%	30—25%	12—10%
106	Engineers—			
	51, under 35 years...	24—48%	23—15%	4— 8%
	55, over 45 years....	5— 7%	26—47%	24—46%

That is, ear affections are mainly found in engineers whose term of service has been very long. The number who complain of subjective noises is very small, doubtless due to dissimulation, on account of fear of losing position.

The Treatment of Oto-Sclerosis by Means of Phosphorus.

Sugar (*Archiv. für Ohrenheilkunde,* Vol. 66, p. 36). As the result of an extensive investigation of the indications and dangers in the use of phosphorus, Sugar concludes:

1. The use of phosphorus in the spongification occurring in oto-sclerosis is not scientific.

2. The method by which it is employed is not to be disregarded.

3. The exhibition of mineral phosphorus, especially in the maximum doses for a period of years, causes grave questionings.

4. The employment of harmless organic phosphorus, especially in the form of phytins is to be preferred in all cases.

Harris.

Nasal Auscultation of the Ear During Catheterization of the Tube.

Laval made experiments on cadaver and the living.

1. Sounds arising at the ostium tubae are heard very loud through the nose, but through the ear are indistinct or a sonorous noise.

2. Those arising in tube are heard equally well through nose and ear.

3. Those arising in middle ear are not audible through nose.

A tube was inserted into the nose as far as the beginning of the middle meatus of nose and held by pressing finger against side of nose.

Drawings illustrate course of sound waves in different conditions of tube.

Contribution to the Knowledge of Pneumococcic Otitis.

E. Dallman (*Archiv. f. Ohren.,* Bd. 64, H. 2 and 3, S. 147) reports a case of fatal pneumococcal infection. When seen, had bilateral otitis media with slight periostitis of right mastoid. The symptoms were so mild that operation was deferred for nearly a month, when patient was suddenly seized with convulsions and died in less than 24 hours. Post-mortem showed extensive leptomeningitis and ventricle meningitis. Bacteriological examination showed pneumococci. The mildness of preceding symptoms is in marked contrast to the extensive meningeal involvement. There was almost complete destruction of the mastoid cells on both sides with formation of sequestra.

A Case of Otogenous Cerebral Abscess Healed by Operation.

H. Mygind (*Archiv. f. Ohrenh.*, Bd. 65, H. 3 and 4, S. 279). The tegmen antri and tegmen tympani had been eroded, allowing access of the pus to the dura, but the latter was only slightly affected, and no direct path of communication between abscess and middle ear could be found. The abscess was very small and apparently recent. The first cranial symptom was a confusion of mind lasting about one-fourth hour, accompanied by loss of memory, and followed by sensory aphasia. The cause was found in the third temporal convolution, probably about the middle. Agraphia was also present, as was paraphasia. Another point of interest was the rapid pulse which appeared after the operation and lasted 18 days.

Capital Operations for the Cure of Tinnitus Aurium.

W. Sohier Bryant (*Journal American Medical Association*, December 9, 1905) thinks that carefully selected cases of tinnitus, with the nerve stimulus located in the peripheral end of the auditory nerve, offer a good prognosis for cessation of the tinnitus after the section of the eighth nerve, and that we are called on to recommend section of the auditory nerve if, after appropriate general and local treatment, grave tinnitus still exists, provided the source of the tinnitus is believed to lie in the peripheral portion of the auditory nerve; and that section of the acoustic nerve will be as effective for the cure of aural vertigo as for peripheral tinnitus. *Richards.*

Report of Cases Seen in the Gottingen University Policlinic for Ear and Nose Diseases During 1903 and 1904.

K. Buerkner (*Arch. f. Ohrenh.*, Bd. 65, H. 1 and 2, S. 1). Among other interesting data, is the following:

External ear	27.79%	1322
Middle ear	67.39%	3205
Internal ear	4.82%	229
Main ear	69.28%	4756
Nose	65.34%	1378
Throat	34.66%	731
Nose and throat	30.72%	2109
Total ear, nose and throat		6865

A Characteristic Symptom of Purulent Thrombus of the Superior Longitudinal Sinus.

Gradenigo (*Archiv. für Ohrenheilkunde,* Vol. 66, page 243). This is a fluctuating, painful swelling occurring at the vertex directly in the median line. It corresponds to one of the foramina emissaria Santorini. The swelling can be filled with either blood or pus. This observation is based on a case of longitudinal sinus thrombosis recently seen by the author where the above condition was present. The history of the case is given.

Harris.

A Sound-Free Room.

Zwaardemaker (*Tydsch. v. Geneesk.*, Feb. 3, 1906) mentioned that there had been made in the attic of the laboratory a small room (2.30 with 2.25 and 2 M. high), the walls of which do not repercuss the sound and into which sounds from without outward cannot penetrate. The first is attained with a trichopiese covering, the second by using six different layers for the wall. The result is satisfactory when no people are on the floor, and no heavy wagons in the street vibrate the entire building.

Blaauw.

Teaching the Deaf Child to Hear.

G. Hudson Makuen (*Pennsylvania Medical Journal*, March 1906). The hearing of the deaf child may be greatly improved by the systematic use of aural gymnastics with the speaking voice used in close approximation to the ear. The training of speech should be carried on simultaneously with the hearing exercises, and the degree of success attained will depend largely on the degree of patience and skill of the teacher.

Richards.

Findings in the Ear of Albinotic Animals.

H. Beyer (*Arch. f. Ohrenheilk.*, Bd. 64, H. 4, S. 273). Animals tested (2 cats, 1 dog) had very little hearing, but were not entirely deaf. The most important findings were degenerative changes in the ductus cochlearis and the organ of Corti. The acoustic nerve was normal except that portion running to the ganglion spirale, it being reduced to a few scattered fibres disappearing at the foramina nervina. The ganglion cells were few and scattered, most numerous in the apex and least in the base.

Technic and Indication of the Extraction of the Hammer and Anvil.

H. Neumann (*Arch. f. Ohrenh.*, Bd. 64, H. 2 and 3, S. 167). Author advises local anesthesia by means of injection of 1 per cent cocain to which 2-4 drops tonogen has been added. The needle is inserted beneath the cutis of the cartilaginous portion of the meatus and shoved forwards under the cutis of the bony part. For complete anesthesia, the entire cutis must be detached. Author reviews technique of and indications for operation.

Psychophysiologic Investigations as to the Value of the Statolithic Apparatus in Orientation by Normal People and Deaf Mutes.

G. Alexander and R. Barany (*Archiv. für Ohrenheilkunde*, Bd. 65, H. 3 and 4, S. 187.) Author tried to find out whether there was any difference in the ability of normal and deaf mutes to distinguish direction of a stroke on the forehead when the head was inclined from its normal position. They conclude that the statolithic apparatus has nothing to do with orientation, as the results were the same in deaf mutes as normal persons.

A Case of Syphilis Hered. Tarda of Both Labyrinths.

Behm (*Archiv. f. Ohrenh.,* Vol. 67, H. 1, p. 74). Sudden deafness is left ear, gradually increasing deafness in right. Treated with mercury inunctions. In one month, hearing for whisper increased to 6 m. in right, 3 m. in left. About one and a half month returned complaining of pain. Left hammer removed on account of adhesions. One year later, sudden loss of hearing in left ear. Inunctions again raised hearing in left to 3 m., at which still remains.

The Technic and Rationale of Bulbus Operation.

A. Iwanoff (*Archiv. f. Ohrenh.*, Vol. 67, H. 1, p. 50) reports two additional cases, one in detail. A fistula was found leading to tip of mastoid. The sinus was discolored, and showed a few granulations. Fluid blood from sinus, ten days later second operation performed in which the bulb was laid bare from above, and found discolored. Jugular vein laid bare 1.2 cm. and whole packed with gauze. Normal healing.

Plasma Cells in Aural Polyps.

R. Hahn and A. Sacerdote (*Arch. f. Ohrenh.*, Vol. 65, H. 3 and 4, p. 300) describe histological structure of polypi. All of the 20 polyps examined showed many plasma cells among the numerous leucocytes and lymphocytes, frequently in larger numbers than the other cellular elements. They were found most numerous in a zone between the center and periphery of the polyp.

Objective Aural Noises.

E. Vali (*Archiv. f. Ohrenh.,* Vol. 66, H. 1 and 2, p. 104) reports a case and thinks that the sound was due chiefly to the clonic contractions of the fibres of the m, tensor veli palatini. It is probable that we do not hear the muscle contractions themselves, but rather that thereby the column of air undergoes movements, which cause the sounds.

Simulation of Sinus Prolapse by Isolated Caries of the Terminal Mastoid Cells.

H. Beyer (*Archiv. f. Ohrenh.,* Bd. 64, H. 4, S. 289). Patient previously operated on for mastoid affection, after some weeks, showed a prominence resembling very closely a prolapsed sinus. A secondary operation, however, showed that it was caused by bluish granulations arising from carious bone.

Contribution to the Knowledge of Acquired Atresia of the External Meatus.

R. Leidler (*Arch. f. Ohren.,* Bd. 64, H. 4, S. 254) recapitulates causes of congenital atresia and gives histories of nine cases. Wherever it was possible, author followed Koerner's method, otherwise he followed Panse's or used a special plastic operation.

A Case of Hysterical Deafness.

J. Thanisch (*Archiv. f. Ohrenheilk.,* Vol. 66, H. 1 and 2, p. 116). Patient had been seen twice for acute attacks of deafness. Awoke one night and could hear nothing. When seen, loss of air and bone conduction. Is still under treatment. Neurotic patient.

Encephalitis and Otitis Grippalis Acuta.

Gerber (*Arch. f. Ohrenh.,* Vol. 66, H. 1 and 2, p. 31). Case of multiple paralysis of nerves associated with otitis media acuta. They were V, VII, VIII, IX, X, XI, XII, all in toto or in parte. This was only on one side, and condition was probably as given in title.

Testing of Hearing by Means of a New Phonometer.

A. Lucae (*Arch. f. Ohrenheilk.*, Bd. 64, H. 2 and 3, p. 155) describes a new phonometer which is his old one much improved. By this, even a whisper can be measured and the loudness of the voice can be measured by means of the excursion of an indicator.

Otogenic Meningoencephalitis Serosa.

Stenger (*Archiv. f. Ohrenh.*, Vol. 66, H. 1 and 2, p. 144) reports three cases. Severe intracranial symptoms caused by increase of cerebro-spinal fluid due to serous meningitis. Diagnoses were uncertain. As soon as the fluid was allowed exit, patients got better.

The Use of Words with Diphthongs for Determination of the Acoustical Acuity after the Method of the Three Fractions.

H. F. Minkema (*Tydschr. v. Geneesk.*, May 13, 1905) has, in conjunction with Van Heerdt, analyzed the Dutch diphthongs ei, yui, ui, au, and ou, an elaboration of the method of Zwaardemaker and Quix. *Blaauw.*

II.—NOSE AND ACCESSORY CAVITIES.

Lupus of the Nasal Cavity—A Clinical Investigation.

Holger Mygind (*Archiv. für Laryngologie und Rhinologie*, Vol. XVII). In an earlier work the author gave the results of his examinations of the larynx and pharynx of 200 lupus patients. These patients had all been under Finsen's care for lupus of the skin, and had been receiving the light treatment. The author in this article gives the results of his examinations of the nasal cavities of these 200 patients. Of the 200 patients examined 57 were males and 143 females. Under the age of 15, there were 8 males and 10 females; between the 15th and 19th years, there were 14 males and 19 females; between the 20th and 24th years, 16 males and 30 females; between the 25th and 29th years, 6 males and 25 females; between the 30th and 34th years, 1 male and 13 females; between the 35th and 39th years, 3 males and 16 females; between the 40th and 44th years, 6 males and 10 females; between the 45th and 49th years, 2 males and 7 females; over 50 years, 1 male and 13 females. Out of the 200 patients the nose was involved in 129. The nasal cavities showed either distinct lupus lesions, characteristic cicatrices, or destructive processes caused by previous lupus lesions. Of the 129 patients, 36 were male and 93 female. Of the lupus patients examined there were 64.5 per cent who presented evidence of lupus in the nasal cavities.

Bender who examined 380 lupus patients found only 30.3 per cent of nasal lupus among them; Leloir out of 312 lupus patients, found 20 per cent with nasal lupus, and Holin found that over one-half of the 106 patients examined by him, had evidences of lupus in the nasal cavities. Pontoppidan found nasal lupus in 40 out of 100 patients. According to the above statistics intra-nasal lupus occurs more than twice as frequently in women as in men. This was found to be so in the cases examined by the author in Finsen's light institute. Among the same 200 patients examined for pharyngeal and laryngeal lupus, it was found that the greater number of cases of lupus of the pharynx occurred in the men and laryngeal lupus in the women. Pharyngeal and laryngeal lupus occurs also more frequently in young adults under the twenty-fifth year than in older people. The fact that lupus involving the mucous membrane of the lower air passages is a much more severe form than that involving the nose, and really shortens life, may be the reason that pharyngeal and laryngeal lupus is not more often seen in older people. Nasal lupus does not materially shorten the life of the patient, and is found just about as frequently in old as in young subjects.

Intra-nasal lupus, as a rule, is secondary to the skin lesions. In only thirteen of the author's cases of intra-nasal lupus, the skin of the external nose was not affected in any way, but in every case the skin of the face was involved. The intra-nasal condition is, too, as a rule, not as severe as the skin affection, and may persist for a long period without much destruction of tisue. Primary lupus of the nasal cavities, while extremely rare, does occur, although Moritz Schmidt in his extensive experience has only seen one case. In the 129 cases of nasal lupus reported in this paper the nasal involvement was secondary in every case.

The nasal vestibule and the region of the alae nasi is almost always involved. In only 7 of the 129 cases there was no evidence of lupus in the nasal orifices. In a number of cases the alae nasi had been entirely destroyed, causing a good deal of deformity.

Lupus nodules were frequetnly found in the septum, and in a few cases the septum itself was destroyed, causing a sinking and depression of the end of the nose. Cicatrices resulting from the destruction of tissue produce frequent changes in the shape of the nares, consisting frequently in narrowing of the nasal openings. This is produced by a uniform contraction of the cicatricial tissue and cicatrices.

Occasionally the nasal opening is entirely closed by the contraction of this scar tissue. The fact that such frequent deformities were found, and comparatively few cases in which lupus nodules were present in the anterior part of the nose, proves that the lupoid process in this part of the nose runs its course very rapidly, and is much more destructive than in other parts of the nasal cavities. Further in the nose lupus nodules occur with much greater frequency. The nasal septum is very frequently involved. In only 35 of the author's 129 cases was there no evidence of an existing or previous lupoid process of the seputm. The lesions are almost always situated on the cartilaginous septum, and practically never attack the bony septum. This is one of the most important points in the differential diagnosis between this affection and syphilis. In a small number of cases, 24, the lesions on the septum consisted exclusively of lupus nodules; in the remainder of the cases the characteristic scars and perforations were present. The lesions, as a rule, are bilateral. Perforations resulted in 58 of the 129 cases, and as a rule there were no nodules around the edges of the perforations. The perforations are usually situated well anteriorly, and vary in size from small pin point perforations to a perforation involving the entire quadrangular cartilage. As a rule, they were from 1 to 2 cm. in height.

The mucous membrane of the inferior turbinate showed lupus nodules in 80 cases, but visible scars were only present in 3 cases. This is due to the fact that nodules involving this part of the nasal mucosa may persist for years without breaking down. The middle meatus is only rarely involved, and nodules were only found in the mucous membrane of the middle turbinate in 16 cases. The posterior nares were only found involved in 5 cases, which proves an earlier investigation of the author's to be true, that lupus seldom extends directly from the nasal cavities to the mucous membrane of the naso-pharynx and pharynx.

Theisen.

A Case of Nasal Tumor.

H. A. Boon (*Tydschr. v. Geneesk.*, Feb. 3, 1906) presented a man who came under his care Sept. 26, 1904, for headache and obstructed right nose. This obstruction had begun two years before, when an ophthalmologist treated him for an obstruction of the nasolachrymal duct. A firm tumor fills the right nose which can not be seen on posterior rhinoscopy; the external nose is broadened; no swollen lymph nodes. Two weeks after operation, obstruction relieved; patient had much pain during the operation and lost much blood. Operations for obstruction were repeated at intervals, shorter in duration. Regional lymph nodes-swelling appeared; weight went down from 60 to 51.5 Kg.; patient became so weak that he could no longer come to the office. Diagnosis is changed to carcinoma or sarcoma. Narath operated on October 31 by opening the right nares externally, removing the tumor from the septum and concha media and the ethmoidal cells. The operation lasted three-quarters of an hour. Healing per primam; nine days later patient was home again. Swelling of lymph nodes and obstruction of the nasolachrymal duct healed without further treatment; his strength quickly recovered. No return up to the present. Microscopic examination, as in the beginning, showing no indication of malignancy.

Boon also found in two out of three cases of nasal tumors that the malignant character was not discovered microscopically: (1) A boy of 17 years, who died after ten months from a tumor which had invaded all parts in the vicinity of the nose, with large conglomerates of lymph nodes in the neck; twice no malignancy was found in parts removed. (2) A mass was removed from the nose of a woman 38 years of age. Symptoms disappeared for one month. Microscopically "lymphoma" was diagnosticated. She died after being under treatment for eight months from an extensive, quick-growing recurrence.

In cases as the one presented, early radical removal externally is indicated as long as the tumor is localized, even if the microscope does not demonstrate malignancy. The cosmetic result is no contra-indication, as can be seen on the patient.

Quix thought that the operation could have been performed endonasally with, of course, better cosmetic result.

Moll did not oppose external operations.

Boon replied that the cosmetic result is very fine. To operate endonasally was impossible, the sudden breakdown of the patient making radical interference necessary.

The Rational Treatment of Multiple Suppuration of the Cavities of the Nose, with Demonstration of a Cured Patient.

V. Delsaux (*Tydschr. v. Geneesk*, Feb. 3, 1906) operated on a 32-year-old patient, who was suffering from chronic suppuration of the right antrum, frontal sinus and ethmoid at the same side. He began with an incision from the middle of the brow along the margin of the orbit, around the inner canthus along the side plane of the nose, finishing in the naso-labial fold. The soft parts were pushed aside, the frontal sinus opened at its lower portion and curetted. The os nasale and ascending branch of the superior maxilla were then resected, opening the nasal cavity widely. Then the antrum was opened at its internal superior and anterior angle, its anterior and inner walls removed and the antrum carefully scraped out. The ethmoid as far as diseased was removed. The entire cavity was now tamponed, the nose replaced and the wound closed. Healing per primam. Removal of the tampons after two days. Complete cure.

Delsaux related four other cases, concluding: To be radical, the operation must make possible the survey and curettage of all accessory sinuses; the entire mucous membrane of nose and its cavities, including all turbinates, must be removed systematically. If this interference is thought serious, we should remember that these multiple suppurations may be harmful, and in that they are a continuous menace to life by fatal complications within the skull cavity.

Posthumus Meyes did not understand why it was necessary always to remove the inferior turbinate.

Delsaux replied that the inferior concha has nothing to do with the frontal sinus, but when the antrum is diseased, it is better to remove it on account of the likelihood of recurrences. Delsaux stated in reply to Zaalberg's question that he operated in double-sided suppuration by turning the nose downward, but as he was not successful he advocates a double incision.

Braat asked about the length of time of the tamponade; Killian leaves them usually in a short time, only two or three days.

Delsaux removes them at the second day, as they produce granulations and suppuration. Sikkel does the same.

Ocular Symptoms of Affections of the Accessory Sinuses of the Nose.

W. C. Posey (*Journal of the American Medical Association*, September 9, 1905) finds many disturbances of the eye to be in intimate relationship with affections of the accessory sinuses. Among these are disturbances in vision and visual field, changes in the orbit, affections of the lachrymal apparatus, of the lids, of the conjunctiva, of the cornea, of the pupil, of the uveal tract, cataracts, errors of refraction, asthenopia, headache and neuralgia.

The headaches of sinusitis occur usually in the morning and are characterized by continuous pain with severe exacerbations which radiate around the orbit and within the zone of distribution of the fifth nerve; or they may take the form of a general head pain, of facial neuralgia or of toothache. Injection of the conjunctiva, lachrymation and photophobia are often present. Its location is significant, and is generally sufficiently characteristic to enable one to differentiate the particular sinus affected.

Neuralgia of the supraorbital nerve is very significant of frontal disease, and dental neuralgia will frequently indicate the existence of antral disease. Frontal headache is suggestive of ethmoidal and frontal disease, while occipital pain is usually caused by sphenoiditis, though disease of the frontal sinus may evidence itself in pain in that locality also. Pain in the vertex and at the back of the eyes is usually caused by sphenoiditis, though, on account of the close proximity of the fifth nerve to the lateral wall of the sinus and the nearness of the sphenopalatine ganglia, reflex pain to any part of the head may be occasioned by disease of that cavity. A distressing pain across the bridge of the nose is peculiar to ethmoid disease.

Richards.

Turbinectomy.

E. Harrison Griffin (*Medical Rcord,* April 14, 1906) thinks partial turbinectomy should be done whenever the inferior turbinate is in contact with the septum, and only sufficient should be removed to establish natural breathing. He saws from below upwards, removing it in such a way as not to hinder its power as a functionating organ.

On account of secondary hemorrhage, he has ceased using adrenalin. Instead he gives, for ten days to two weeks before the operation, two grains of quinine after each meal and ten grains at bedtime, and with the bedtime dose twenty grains of potassium bromide in solution. This will reduce the chance of a hemorrhage to a minimum. When the patient first applies for treatment, the turbinate will be found a dark red in color, very much swollen, and the canal much narrowed by the swollen membrane encroaching on its lumen. Examination after a week's treatment with quinine and the bromides will show the membrane much reduced in size and of a much healthier color.

At the time of the operation he plugs the nose with a long piece of absorbent or plain antiseptic cotton, about six inches in length, the major part of which is removed the following day. When the patient is given ten grains of quinine and twenty grains of potassium bromide, he finds secondary hemorrhage very rare. The internal treatment with the quinine and potassium bromide is continued for two or more weeks after the operation.

It would seen to the reviewer as though this was an excessive amount of quinine, and would be more than many patients could comfortably take. *Richards.*

Two Cases of Osteoma of the Ethmoid.

H. De Stella (*Tydschr. v. Geneesk.*, Feb. 3, 1906) was called to examine the nose of a 17-year-old girl, who had consulted the ophthalmologist for proptosis with diminution of the visual acuity. He found the left nose filled with hard, bony tumor, which pressed against the septum and projected into the naso-pharyngeal cavity; behind it was free and attached to the ethmoid. The left naris had been closed for years. He made the diagnosis of osteoma of the ethmoid and considered removal through resection of the upper jaw impossible, so he operated, as Moure, with an incision along the supraorbital margin and the side of the nose as far as the upper lip, with removal of the nasal bone and the outer wall of the antrum. After the operation the bony walls of the orbit were pressed in, the eye replaced and the wound entirely sutured. Healing in two weeks, position of the eye normal, nose free, recurrence not to be expected.

His second case, a boy of 21 years old, was also sent him by the ophthalmologist, who was consulted for exophthalmus and diminution of sight for six months at the left side. A hard, bony tumor was found at the inner side of the orbit, apparently originating from the lachrymal bone. In the nose there were deviation and spur of the septum, but no tumor. In the eye there was advanced retinitis atrophica. The incision was made as in the first case, the bulb pushed outward and the tumor cut off from the ethmoid. The wound healed quickly.

Blaauw.

The Submucous Resection of the Septum Illustrated.

William L. Ballenger (*Pennsylvania Medical Journal,* March, 1906) offers the following axioms in connection with this operation:

Make haste slowly in starting the elevation of the mucoperichondrium. Any other manner of haste is liable to result in a permanent perforation.

Do not extend the Killian incision through both mucous membranes, on account of the danger of perforation.

Introduce as few instruments as infrequently as possible between the membranes.

Do not "fish" for what you want, but look, see, feel, comprehend, then remove what you want. "Fishing" in the cavity is liable to tear the mucosa.

A sharp-pointed instrument in a cavity is a dangerous thing. A dull one is safer.

The mucoperichondrium is easily and quickly lifted with a blunt elevator in 95 per cent of all cases.

The external ridge of the nose needs support, hence, leave plenty of cartilage in this region for this purpose.

Do not operate to straighten the septum, but rather to remove obstructive lesions of the septum, and with a view to the patient's comfort and permanent relief.

The article is illustrated pictorially, and should be carefully studied by anyone desiring to do the operation, who has not already acquired satisfactory technic. *Richards.*

Three Cases of a Foreign Body in the Antrum.

P. Th. L. Kan (*Tydschr. v. Geneesk.,* Feb. 3, 1906) reported the following three cases:

1. A piece of straw 3 cm. long was found on making a radical operation on the left antrum for chronic fetid suppuration. Four years ago the antrum was opened through the alveolus, and patient not being able to smoke, as no prothesis was used, closed the opening with different things.

2. A revolver bullet, which perforated the septum anteriorly from the left side and reached the right inferior turbinate 1 cm. behind its anterior extremity and then passed into the antrum. The bullet would have been expected, from its course in the nose, to be at the bottom of the posterior wall of the antrum, but it was found after chiselling away the anterior wall of the antrum, half in the ethmoid cells, half in the antrum, while the right lamina papyracea was pressed outward. Kan supposes that the bullet reached so high up because the woman threw her head backward, as in resistance to the shot.

3. Also a revolver bullet in the right antrum of a 41-year-old man, who tried to commit suicide by shooting into the left temple. The bullet went through the left lobus temporalis and left orbit—without injuring the bulb—the left ethmoid and middle turbinate; perforated the septum, and reached the right antrum through the inferior turbinate. Kan saw patient seven weeks after the accident and found a broad synechia between middle turbinate and septum in the left nose. A radiograph showed the bullet in the antrum, which was removed after opening the anterior wall; there was no suppuration present. *Blaauw.*

Transplantation of Bone for the Relief of Saddle-Nose.

CULLEN F. WELTY (*The Journal of the American Medical Association*, November 11, 1905). The saddle-nose was due to an injury occurring two years before. There was some obstruction of the nasal cavities, which was first corrected. An incision starting just below the union of the nasal bones was carried well into the tip of the nose, cutting down to the cartilage proper, separating the perichondrium in the hope that the implanted bone would form union at this place. At either end of the incision, the skin and fascia were undermined so that the bone could not be displaced. The skin and fascia from the sides were likewise dissected loose as these tissues were drawn tight over the bridge. A piece of bone two inches long and the thickness of half a lead pencil was then removed from the crest of the tibia, and with it more than enough periosteum to cover it. Its edges were trimmed with a pair of scissors and it was then adapted to the cavity in the nose which had been made for it, and the wound closed with deep sutures. The periosteum of the tibia was sutured with catgut and the skin with silk. No pus appeared from either wound. The result was satisfactory. *Richards.*

Foreign Body in a Syphilitic Nose.

P. Th. L. Kan (*Tydschr. v. Geneesk.,* May 13, 1905) found a piece of guttapercha, 5 cm. long, and 4 cotton wads, enclosed in a discolored odorous mass, in the nose of a patient, in whom the entire bony and cartilaginous septum had been destroyed and the palate perforated by syphilis. A physician had given this to him in 1878 as a prosthetic appliance for his perforation. *Blaauw.*

III.—MOUTH AND PHARYNX.

The Significance of Edema of the Pharynx.

J. E. Schadle (*Laryngoscope,* February, 1906). The association of edema of the pharynx with acute nephritis, the author states, is a rare observation, and deserves mention on account of its clinical importance.

An epidemic of tonsillitis that prevailed in St. Paul is described. Adults and children were affected alike. The tonsillitis was of follicular variety, and was no doubt infectious in its nature. Its toxic character was shown by such complications as cervical adenitis, a low form of continued fever, general debility and subsequent anemia. Convalescence was slow, and evidently retarded by systemic poisoning. A study of the disease made it apparent that the tonsillar tissue served as a portal for bacterial invasion of the lymphatic glands and the general circulation. Albumin was not uncommonly found in the urine, and in a certain percentage of the cases, active inflammation of the kidneys was induced and formed a grave aspect of the disease. Acute exudative follicular tonsillitis is not always a local disease per se, and as is well known may extend beyond the throat, and through its toxic influence involve organs more or less remotely situated. For this reason, persons suffering from this form of tonsillitis should receive the most guarded attention. As is well known, edema may be local or general, circumscribed or diffused. The writer desires to call special attention to edematous infiltration of the pharynx. This is a rare affection, and is of special significance and interest and, as is illustrated by the history of the following case reported by the writer, the condition bears a significant relationship to acute nephritis.

E. M. W., aged 70 years. During convalescence from a sharp attack of influenza, patient's temperature suddenly rose to 103° F. with chill, and he presented the usual signs of quinsy, the left tonsil being affected. Under treatment the local lesion and fever subsided in 48 hours. On the following day the temperature rose to 101.6 and he developed suddenly a brawny swelling at the angle of the left jaw. A few days later symptoms of dyspnea suggested a laryngeal edema, but on examination of the throat the larynx was clear, but there was a marked edema of the pharynx. The left side of the pharynx was much swollen, and the lymphatic glands of the neck on the same side were greatly enlarged and painful on pressure. The swelling in the throat extended downwards toward the larynx, and across, anteriorly, toward the base of the tongue. The conclusion arrived at was to the effect that the condition was either an edema pure and simple, or that there was pus deeply seated either in the neck or throat. Deep incisions were made into the pharyngeal tumor, but no pus was obtained. A serous fluid issued from the incisions, and gave the patient temporary relief from the difficulty in breathing he had been having.

On examination of the urine, a large amount of albumin, and casts, were found. The result of this examination appeared to the writer to give a satisfactory explanation of the cause of the local phenomena appearing in the throat and neck. He considered that the patient had been suffering from an infectious nephritis brought on by an attack of tonsillitis.

After the kidney lesion disappeared there was no return of the pharyngeal and lymphatic complications. *Theisen.*

Concerning Periodic Recurring Hemorrhages from One Tonsil Directly Before the Beginning of Menstruation.

M. WUNSCH (*Deutsche Medicinische Wochenschrift*, No. 38, 1905). The following case is reported: A young woman, aged 25 years, consulted the writer for the relief of bleeding from the mouth, which came on directly before each menstrual period. The patient herself noticed that the bleeding came from the right tonsil.

An examination of the throat showed on the right tonsil a small blood cot. There was no ulceration of the tonsil, nor was it enlarged. The throat in other respects was perfectly normal.

Menstruation was regular and of a normal type. Vicarious hemorrhages in women from the nose, stomach, lungs, from hemorrhoids and wounds have been frequently described. Hesch describes a case of fatal hemorrhage from the lungs, which he attributes to vicarious menstruation. Kidalen describes vicarious menstruation in cases of defective development of the uterus.

Rheinstein has reported a case from the mucous membrane of the Fallopian tubes.

In the majority of the cases the menses are absent or scanty. In conclusion, the author states that hemorrhages from a perfectly intact tonsil are so rare that the report of his case was of some interest. *Theisen.*

A New Instrument for Removal of Hypertrophied Tonsils With the Cold Snare.

J. G. HENKES (*Tydschr. v. Geneesk.,* Feb. 3, 1906) uses the cold snare in a sort of forceps which enables one hand to produce enough force to pull the snare through the tonsil, the operating hand being under the mouth of the patient. The steel wire must be thin and tough. He used it with 150 patients, 107 of which were under 5 years old; the bleeding was minimal and the wound healed in general sooner than with the tonsillotome. It is the instrument of choice for little children (made by Wilh. Walb, Nachf., Heidelberg).

Zaalberg used the Henkes' snare with four children; twice it went all right, once the blade was loose, once the wire broke. He prefers the forceps of Ruault.

Henkes states that the screws must be well connected and the right kind of wire chosen. When the snare does not cut, the wire is too thick. *Blaauw.*

A Case of Tonsillolith.

H. J. L. STRUYCKEN (*Tydsch. v. Geneesk,* Feb. 3, 1906), removed a tonsillolith from a patient, who had before spontaneously removed small pieces. A firm, hard tumor was in the soft palate over the left tonsil, from which, after incision, the stone was removed; it was 2.5 cm. long and 1.5 broad and thick. *Blaauw.*

Governmental Inquiry as to the Frequency of Adenoids in School Children.

H. BURGER (*Tydschr. v. Geneesk.,* May 13, 1905). In September, 1903, the Minister of the Interior sent a letter to all teachers connected with the primary education asking their co-operation in finding out the number of sufferers from adenoids among the school children. They received a pamphlet, wherein the important symptoms were described, and they were asked to state the number affected. For these the following report was to be made: 1. Whether they breathe through their mouth while sitting; 2. During sleep; 3. Whether they complain of headache; 4. Whether they are behind in their class; 5. Whether they speak with a nasal voice; 6. Whether they stutter; 7. Presence of deafness; 8. Of earache; 9. Presence of the disease in brothers or sisters. The result was that some 6 per cent of all school teachers were supposed by the teachers to suffer from adenoids.

No public discussion would have been held as to these preliminary results, if the president of the Central Sanitary Council had not asked this body for advice.

The Sanitary Council wished information about 4 questions, to which 15 members of the society responded.

1. Did more children come under treatment in 1904 than in the previous years, supposed to suffer from adenoids? Can it be stated in per cents? Ten members answer affirmatively, one giving an increase of some 30 per cent.

2. Were more patients treated for adenoids in 1904 than previously? Can it be stated in per cents? Fourteen members answered in the affirmative; one did not see any increase. The increase varied from a slight percentage to even 60 per cent. The interest of the public was clearly shown, partly due to the late Prof. Guye's agitation of the question, partly because this condition was brought before the public, even in the parliament.

3. Have many of these sufferers been sent by the teachers? Can it be stated how many of their suppositions were correct? All members but one affirm. Only two could give a percentive relation. In one case the teacher had sent 18 children, 12 (66.7 per cent) of which had adenoids; the other member found half of the cases to be sufferers of adenoids, or enlarged tonsils with or without adenoids (of the other 50 per cent, 30 per cent had a narrowing of the nose, 20 per cent no anomaly whatever, or mouth-breathing through other more distant causes).

Burger mentions his experience with a school for backward children. Its head, Mr. Schreuder, takes particular interest in this topic; his supposition was right in 23+13=36 times (67 per cent) and wrong 10+8=18 times. Of these 63 children, 40 suffered (63.7 per cent) from adenoids. Although the teachers showed a varying spirit, some only looking for the open mouth, others for headache or backwardness in learning, coloring the statistical tables accordingly, it can be thankfully acknowledged that a very great number of children in different parts of the country are recognized as sufferers from adenoids and are cured under proper treatment.

Burger considers examination with the finger only allowed with school children, when the parents give their consent. Mirror examination is most to be recommended. With posterior rhinoscopy three degrees may be distinguished: in the slightest, the swelling reaches or just passes the choanal arcs; in the second, it reaches the superior third of the choanae; in the highest degree, a large part of the choanae, half or more, is covered by the adenoids. From 15 to 20 per cent, however, of the children can not be examined in this way; these must be excluded from the statistics. Taking together 11 tables of statistics, including 13,283 children, adenoids were found in 30.2 per cent (4,014); these statistics are all based upon direct examination of the naso-pharyngeal cavity; 3.3 per cent were found suffering from speech defects and abnormal facial expression; 16 per cent in subjects where all external signs, including acoustical acuity, were taken into account. This shows that the external signs are entirely insufficient as a base for statistics of adenoids, as a very large number of the cases, possibly, four-fifths or nine-tenths, remain undiagnosticated.

4. Does experience show, after removal of adenoids, great amelioration of symptoms which could be of disadvantage in the future life of the patient? Nine hundred answered in the affirmative, only one said "no" without further explanation; so that we may conclude that a large experience has demonstrated the amelioration of symptoms, which are of considerable interest from out a social standpoint. Deafness is most important. Of the 2,303 adenoid cases treated between September, 1896, and January, 1903, in the dispensary at Amsterdam, 56.4 per cent (1,299) suffered from catarrh or inflammation of the middle ear. Deafness, disturbed sleep, headache, aprosexia diminish not only the vital pleasure of the children, but they prevent—in very different degree—their intellectual formation, and can be cured in a large percentage immediately and permanently. The development of the body may also greatly suffer; disturbance in the development of the thorax, chronic tracheal and bronchial catarrhs, asthmatic con-

ditions, anemia, general debility, early fatigue, want of cheerfulness, great susceptibility, small resistance power, bad temper, poor appetite; these are a part of the disturbances mentioned by different writers, more or less properly as caused by adenoids. The examination of the blood shows a slight anemia and leucocytosis, which becomes normal after removal. The hemoglobin has been found less than normal and also the alkalinity of the blood. Adenoids may produce all symptoms of scrophulosis, which removal cures.

Efficient removal of the adenoid vegetations in the first years of school life must, from a social point of view, constitute, without doubt, an important gain in health and active power of the people. Systematic guidance of the public is of great importance, also regular instruction of the teachers connected with primary instruction is necessary. At present insufficient help comes from the physicians themselves, as they are in the main uninstructed in the pathology of throat, nose and ears. With a better understanding on the part of the general physicians, many years will still pass before this will influence the recognition and relief of the adenoids. Therefore school-physicians are necessary who have a special study of school hygiene, dermatology, ophthalmology and oto-rhinology.

In the discussion, Zaalberg stated that with Ten Cate he began an investigation in the public schools of Amsterdam. Digital examination was not permitted, but the number in which rhinoscopia posterior fails is small. They examined one school with 500 pupils. Of the 252 boys 32 per cent of the 248 girls 34 per cent, had adenoids. They distinguished as to the degree "much," "moderate," "little," and "a trace." The pupils were designated by the teachers as "bright," "moderate" and "with small progress." Of the 67 bright boys 14 per cent, of the 135 moderate 17 per cent, of the 47 small progress 21 per cent (average 17 per cent) had "much" adenoids. Of the 46 bright girls 4.3 per cent, of the 146 moderate 14.5 per cent, of the 57 small progress 24.5 per cent had "much" adenoids.

Burger replied that a typical distinction between hypertrophy of the pharynx tonsil and adenoids is not made at present, as no real difference exists whether the hypertrophy has the shape of a tumor or of more separate lobes. Only a small number of the adenoid cases are recognizable by the external signs. It is a mistake to think that only those external recognizable cases should have a pedagogic and sociologic interest.

Blaauw.

IV.—LARYNX.

The Observation and Photography of Speech Sounds.

H. J. L. STRUYCKEN (*Tydsch. v. Geneesk.*, Feb. 3, 1906) showed an instrument wherewith sound vibrations, transferred through the air, can be observed with an enlargement of 600 times. With a very strong illumination (sunlight) and quicker rotation-oscillation of the total reflecting prism, waves can be observed produced by tones of even more than 20,000 vibrations. The speech sounds also, vowels as well as consonants, can be easily seen even when spoken at a distance of a few meters. The curves, even of the most simple vowels, show a thousand different changes in form; during phonation slight changes of the structure continually takes place.

The curves may be photographed, but the enlargement must then not be over 200 times with an illumination of 1/30000 second.

Struycken tried to solve, in the following simple way, the problem of accurate determination of the time: a fine elastic hair is fixed to one prong, which hair begins to vibrate with an amplitude 10 to 50 times larger than the prong itself, as can easily be demonstrated experimentally. It makes the same number of vibrations as the prong, but is nearly always in phase contrast. This hair is put at the light side of the very small slit, which intercepts the enlarged image of the vocal waves. The cylinder lens transforms the shadow line into a shadow point, which draws a curve on the film with macroscopically visible amplitude, while the vocal waves are taken undisturbed at the side. The very small, narrow tuning fork, to which the hair is fixed, vibrates only very weakly, so that the air waves made by it cannot influence the structure of the vocal curves. Next to each other and, independently, sound curve and sinus line of the tuning fork come on one film. If necessary, an almost perfect certainty of 1/10000 second may be reached when the tuning fork has a normal of 3000 vibrations a second.

This method can be used with profit for observation of speech sounds, for comparison of pitch, for comparison of the amplitudes at different distances and at different pitch, even for measuring the sound velocity at very short distance.

Zwaardemaker deplored that the speaker held his instrument under cover. He does not consider it well to demonstrate and hide at the same time instruments and methods. The largest merit of the method here shown is the reproduction of very weak sounds photographically. He knows of only one other instrument which does the same: the string galvanometer of Einthoven.

Quix considered it unheard of to demonstrate an instrument under canvas. So the experimentum crucis fails. He had a great objection against analyzing vibrations of a membrane. One never knows how much of the reproduction corresponds to the speech sounds.

Struycken replied that the instrument is very frail. The covering did not hinder the sound-waves and served to stem the air current. He considers it pretty certain that the vibrations observed are really sound-waves, as for each pitch always a proportionate number of waves is observed.

Blaauw.

Demonstration of Mirrors for Endolaryngoscopy.

Th. E. Ter Kuile (*Tydschr. v. Geneesk.,* May 13, 1905) had a mirror made wherewith he can inspect in a sagittal direction the inside of the larynx. With the ordinary mirror one looks in a rostrocaudal direction and sees only along the posterior wall. With Killian's method we look in many cases obliquely at the posterior wall, especially at its superior part. His new mirror can be called "posterior wall-mirror" and is made by H. Pfau, Dorotheenstr, 67 Berlin, N. W. The reflecting plane is an oval of 14 by 9 mm.; the large axis is here in the vertical direction, the small one in the transversal one. The larynx is made anesthetic with 20 per cent cocain. The ordinary mirror is placed at the uvula and then the posterior wall-mirror put in. In case the epiglottis hangs over too much towards the posterior wall the patient must phonate, when the mirror will easily pass this barrier. The epiglottis is then further fixed by the vertical part of the handle of this mirror anteriorly. While the posterior wall-mirror slides downward we see successively the posterior wall of the pharynx entrance of the esophagus, the upper border of the arytenoid region with the incisura santorini, then the mucous membrane of the posterior wall and still deeper that of the cricoid cartilage which appears white. The advantage of this method is that the posterior wall is seen in normal position; the image in no way is reversed. If the posterior wall-mirror is turned around, the angle between the posterior and lateral wall of the larynx may be seen, which the ordinary laryngoscope does not show. The most striking are the upper border of the posterior wall of the larynx with the incisura santorini and the mucous membrane of the posterior wall of the pharynx, which is somewhat paler, often with transverse streaks. The mirror must be turned to the right or left when the noduli santorini is to be seen. To see the cricoid, the larynx must be well cocainized. The mirror is the most useful for those cases for which it was made, viz., where there is question as to the presence of an ulcer on the posterior wall of an otherwise normal larynx. The diagnosis is also facilitated between subacute swellings of the mucous membrane of the posterior wall and beginning chronic ulcerative tuberculous and luetic processes of the larynx.

Blaauw.

A Case of Congenital Laryngeal Membrane.

ZALEWSKI (*Fränkels Archiv.*, Vol. 16, No. 3). Cases of congenital diaphragm of the larynx are so rare that the author considered the following case well worth putting on record:

The patient, a man aged 25 years, came to the clinic in Lemberg, complaining of difficulty in breathing, which troubled him particularly when he walked or climbed hills. Hoarseness was also present. The distressing symptoms had been worse for a year, but the patient stated that his voice had never been clear.

He had never suffered from lung or throat troubles, and had a good family history. Laryngeal examination showed the presence of a membrane in the anterior part of the larynx, under the vocal cords, which filled the larynx, with the exception of a small round opening posteriorly. The cords themselves merely showed the evidences of a slight chronic laryngitis. The movements of the cords were normal. It was found, when an examination was made with a laryngeal probe, that this membrane was thin and rather elastic, extending posteriorly two-thirds the length of the vocal cords, and appeared to be adherent to their under surface. Other than this, the larynx did not show any pathological changes. The author removed the membrane endo-laryngeally, with Störks' double pincette. The voice became clear immediately, and the difficulty in breathing was also at once relieved. The author believes that this was undoubtedly a congenital membrane, because it was situated in the place where they are usually found, and because no other changes that could account for the formation of the membrane were found in the larynx.

Very little is known concerning the origin of these congenital membranes.

Hansemann considers that they may be due to an intrauterine inflammation of the larynx. Other investigators consider that they are anomalies of development. Only operative procedures are indicated in treating such conditions.

In the majority of the cases, endo-laryngeal operations can be performed with cocaine. In cases, however, where the membrane is very thick and tough, laryngo-fissure may have to be performed. Fein has collected only sixteen cases of this interesting condition from the literature. *Theisen.*

Measuring of the Intensity of the Voice.

H. F. MINKEMA (*Tydschr. v. Geneesk,* Feb. 3, 1906) refers to the experiments of Wolf in 1871, and of Lucae, who made his phonometer in 1872 for determinating of its intensity. In Band. 64 of the *Arch. f. Ohrenheilk.,* Lucae gives an improvement of his instrument, which records the amplitude of a glass membrane, which is moved through air currents produced during whispering. The vocals and consonants p, b, œ, o, weak in an auditory sense, give the largest amplitude. Words which begin with explosives should, therefore, be used with this instrument.

Reuter made such an investigation with the anemometer, where he got a measurable amplitude only with œ, o, p, b.

Minkema investigated the whisper voice-currents with a simple tube of Pitot. This tube was connected with an aerodromograph and the velocity of the air thus registered. It is clearly shown that only œ, o, ui, ou, p, b, f, give expression to amplitude; with the whispered s, a negative amplitude was produced, probably by air vortex.

Zwaardemaker determined with the aerodromograph the intensity of the singing voice; the expended energy swung between 0.45 and 0.95 megaerg.

Minkema tried with the phonograph to calculate the intensity of the voice. He used the results of the analysis of Fourier of the word "een." *Blaauw.*

Improved Clipping Forceps for Removal of Growths of the Vocal Cords.

H. J. L. STRUYCKEN (*Tydschr. v. Geneesk.*, Feb. 3, 1906) finds that the usual forceps have the following disadvantages: (1) The cutting end moves in those where the beak is pulled in a tube to close them. (2) The entire forceps moved when the handle is pressed in those which open with a hinge. (3) Those without these disadvantages cut in a horizontal plane, so that the growth can only rarely be well grapsed, and those which cut vertically have the lower bill dull and broad, which makes it very difficult to introduce it between the vocal cords in the anterior commissure. (4) It is generally impossible to see in the mirror which part really is grasped between both jaws of the beak.

Struycken hopes to overcome these disadvantages with his forceps: (1) The forceps possesses the three-ringed handle of Pfau, which keeps the beak in place while it is closed. (2) The upper jaw is fenestrated so that the part grasped may be seen; it is placed at an angle of 20° with the horizontal plane downward, so that the forceps, when it is kept a little oblique becomes nearly horizontal. (3) When the opened beak is introduced, the inferior jaw is vertically downward and its point goes easily between the vocal cords and keeps to the anatomic relations in closing. (4) The beak cuts from below upward and entirely through, that is, without dead space (it is never necessary to tear); it is movable in every position vertically and can be made in all sizes.

Blaauw.

Keratosis Laryngis Circumscripta.

I. C. HENKES (*Tydschr. v. Geneesk.*, May 13, 1905) showed a 13-year-old girl, who came under his care for hoarseness. Her voice has not been more clear since her 6th year, at present, it is almoſt aphonic; there is no cough; general health good. The false vocal cords are slightly swollen. The vocal cords have tumor-like new formations on both sides, somewhat anterior to the vocal processes, which originate with broad base from the free margin and stand out into the glottis. They are of a light-yellow pink color and a firm consistency. The anterior third part of the vocal cords shows the same intumescences but smaller. On phonation these growths press on each other and fit in as the teeth of a cogwheel. Patient suffered from psoriasis universalis inveterata since her second or third year.

Blaauw.

Three Rare Laryngeal Tumors.

W. Posthumus Meyes (*Tydschr. v. Geneesk.*, Feb. 3, 1906) demonstrates:

1. A firm, knotty, oblong tumor, in section 3.5 and 2 cm., which was found with the laryngoscope adherent to the right pharyngeal wall with a thin pedicle, almost closing the entrance of the larynx. The patient was 64 years old, healthy-looking, complaining of increasing difficulty of swallowing solid food for a year; no dyspnea, speech perfectly clear. On palpation the tumor was found hard, uneven, movable and painless, while the attachment to the pharyngeal wall was harder than the surrounding tissue into which it passes in a regular way. A distinct infiltration can be felt externally in the neck, without glandular swelling in the surrounding tissues. The diagnosis was made of a malignant newformation, carcinoma or sarcoma and the tumor was removed with the galvanocautery snare, with slight bleeding. Dr. Driessen made the microscopic diagnosis of sarcomatous-carcinoma. A recurrence of the size of the original tumor formed within eight weeks, with enlarged externally palpable swelling and some hard lymph nodes. Prof. Lanz performed pharyngectomy.

2. A semi-globular, firm tumor of the size of a small egg, weighing 28 grains, removed from a boy 8 years old, who became gradually affected for a year and a half with attacks of suffocation; the child was emaciated on account of dysphagia and very cyanotic. A severe inspiratory dyspnea was present as if from serious larynx stenosis. On opening the mouth a tumor was seen moving up and down with every respiration, glossy, quite smooth and pale, which seemed to close the pharynx from all sides with every inspiration. The tumor could be palpated without pain as far as the aditus ad laryngem, and was connected with a thin pedicle to the inner right undersurface of the epiglottis. Meyes tore the pedicle with his finger; bleeding was insignificant. The mirror showed a bleeding spot at the base of the epiglottis near the right crico-arytenoid articulation; the larynx was normal otherwise. Macroscopic appearance and microscopic examination confirmed the diagnosis of lipoma. The pharyngeal wall was everywhere atrophic where contact had existed with the tumor, as if polished by the rubbing of the tumor. Patient entirely recovered.

3. A pale, smooth, broad-pedicled tumor of the size of a pigeon egg, removed the day before from the throat of a child 16 months old. The mother had noticed when it was 4 months

old that it had a pedunculated tumor in the throat, which sometimes lay on the tongue, and when it was invisible the child was very much oppressed. The family physician should have removed it by tying off the pedicle. Since then child remained healthy, until some months ago, when deglutition became more difficult. Inspection shows between pharyngeal wall and soft palate a projecting whitish globular tumor, which entirely fills the left part of the cavum pharyngo-nasale. On palpation the tumor is smooth, pseudo-fluctuating, movable, with a thick pedicle connected high up with the posterior left side of the soft palate. The peduncle was tied as high as possible and removed with a cold wire snare. Macroscopic section shows a lipoma.

Blaauw.

V.—MISCELLANEOUS.

Radiography of a Tracheal Stenosis (through Enlargement of the Thymus).

H. J. L. Struycken (*Tydsch. v. Geneesk,* Feb. 3, 1906.) examined the patient first at the age of two years, for symptoms which made the physician suppose some croup process was prescent. Struycken did not find any membrane on autoscopic examination, but he thought that a tracheal polypus under the glottis produced a stenosis; on expiration the lumen closed almost entirely, and the air passed well during inspiration. Inferior tracheatomy did not relieve the symptoms, but relief followed the introduction of an elastic catheter with evacuation of a very large quantity of muco-pus. A canula was introduced and well retained. The general condition improved rapidly, but the dullness over the manubrium sterni remained. The diagnosis remained wavering between thymus hypertrophy, lymph node swelling, malignant newformation or vessel ectasia. Looking along the tracheal wound the posterior wall was seen to bulge into the lumen, the cartilaginous rings were weakened somewhat, 4 cm. beneath the upper margin of the manubrium sterni. With every expiration this wall pressed against the opposite side, which had given before the impression of a polyp. Fever and vessel sounds were absent; careful puncture externally to the trachea was without result.

During the past 4 years the dullness increased, but diminished during the last half year. At the place of dullnes a distinct shadow can be seen by means of radiograph, made by Dr.

Bynen, Jr. Notwithstanding the canula, the child can speak well and its general condition is satisfactory. The parents altogether opposed more radical treatment. *Blaauw.*

A Distinct Type of Respiration with Asthma, According to Photographic Pictures.

TEN HAVE (*Tydschr. v. Geneesk.,* Feb. 3, 1906) examined a number of normal persons and five asthmatics with Zwaardemaker's aerodromometer (small aluminum disc hung up in a vertical respiratory tube between two spiral springs). With these latter he found, without exception, a distinct altered respiratory type, which is not found in the usual respiration of normal people. Notwithstanding that respiration is somewhat slower and but slightly deeper than normal, the expiration of the asthma sufferer, outside of paroxysms is of such a nature that the velocity of the current quickly reaches a certain maximum in the first half of the expiratory phase, and decreases again directly and remains small during the second half. Although it is a known fact that expiration mostly is clearly lengthened in asthmatics and emphysematous patients, this demonstrated particularity of the respiratory current had not been observed by the investigators. It is very manifest in the motions of this aerodromometer followed chronophotographically, just as with the aerodromography demonstrated in 1904, because the recordings of these instruments represent somewhat exaggerated the changing velocities of the air current. The aerodromograph (demonstration 1904) gives records proportionate to the quadrants of the velocities.

Blaauw.

The Use of Thiosinamin and Fibrolysin in Otology and Rhinology.

L. HIRSCHLAND (*Archiv. f. Ohrenheilkunde,* Bd. 64, H. 2 and 3, S. 107). Author reports previous findings of others in regard to thiosinamin and describes a more recent preparation called fibrolysin (first reported by Mendel in *Therapeut. Monatsh.,* Feb., 1905), which is a double salt of thiosinamin and sodium salicylate. It is easily soluble in water, but decomposed in the light, so it is put up in small brown pearls, each containing 1.5 cm. of fibrolysin in 8.5 cm. of water. Remedy can be given like thiosinamin, either internally, subcutaneously, intramuscularly or intravenously, efficiency increasing in order named. Author used ½ Praraz syringe of 10 per cent solution, thiosinamin in glycerin, 3x in first week, 6x in second week and 6 whole syringes in third week. The action requires more or less time to make its appearance. Cases of labyrinthine or nervous deafness, in very old people, artereosclerosis and cases of otitis media with ossification, are not adapted to the treatment. Even if hearing is not increased, tinnitus is usually improved. The treatment must be coupled with the ordinary mechanical treatment. The use of thiosinamin or fibrolysin is devoid of danger. *Blaauw.*

Post-Diphtheritic Palsies and Serum Injection.

H. De Stella (*Tydschr. v. Geneesk.*, Feb. 3, 1906) demonstrated in 1904 that injected serum does not remain long in the blood, but is absorbed by the cells and tissues, even when they produce the poisons or when the poisons are already present. They are neutralized by the antitoxin only when the connection is made within a quarter of an hour. Still, according to the French, serum injection is advocated for post-diphtheritic palsies. De Stella was convinced that it can do no good here, as it cannot break the connection of poison with the protoplasm. He therefore experimented with two groups of rabbits of nearly the same size and weight, in which he produced paralysis through injections of diphtheritic poison. Five days after the last injection, he took ten rabbits of group A and injected them during five and ten days with serum, and left ten rabbits of group B undisturbed. He did not find the least difference in the healing of the paralysis of the rabbits of group A or B. *Blaauw.*

A Foreign Body in the Right Bronchus, Removed by Means of Bronchoscopy.

P. Th. L. Kan (*Tydschr. v. Geneesk.*, Feb. 3, 1906) treated a 6-year-old girl, who had aspirated a bean two days ago; the oppression slowly increased; brought in the hospital she could breathe only in sitting posture. There were distinct changes on percussion and auscultation over the right side. As the size of the bean was unknown, tracheotomy was performed; a tube 15 cm. long and 9 mm. in diameter was introduced and a bean, impacted in the right bronchus, could be seen covering the bifurcation. Only a crescent-shaped slit remained for the air to reach the left bronchus. On pulling at the trachea or bending the head backward the slit became so narrow that suffocation symptoms appeared. He seized it with a sharp hook and removed this together with the tube. The hook held only a part of the shell. The tube was reintroduced and the hook pressed in deeper. Removal of the instruments now was successful; all troubles disappeared and patient entirely recovered.

Blaauw.

Lipoma of the Esophagus.

P. TH. L. KAN *(Tydshr. v. Geneesk.,* Feb. 3, 1906) found this rare tumor on a 66-year-old woman. She had but slight trouble from the tumor, which she could bring in the mouth by a movement of tongue and pharyngeal walls. When she swallowed the tumor, it could not be seen laryngoscopically. She had a large subcutaneous lipoma on her neck. She was operated on twelve years previously for the same kind of tumor. The place of origin of the tumor could not be made out. Radiographs were made after a lead bullet was attached to the tumor and patient had swallowed both, but on the plates no shadow of the bullet could be found.

Prof. Korteweg removed the tumor per vias naturales with a pair of forceps, by which the pedicle was grasped and twisted. The specimen fixed in formol was 5 cm. long with a width and thickness of 2 and 1.5 cm.; it consisted chiefly of adipose tissue. Kan believes that the place of origin must be looked for in the superior part of the esophagus.

Prof. Zwaardemaker stated that instead of the lead bullet bismuth pellets could have been used.

Foreign Body in the Bronchus.

H. H. GERMAIN *(Journal of the American Medical Association,* July 8, 1905). Child of twenty-one months inhaled a peanut kernel. Tracheotomy was done without relief, and nine days later without anesthesia, No. 25 French endoscope introduced through the tracheotomy wound, and a half kernel of peanut could be seen in the right primary bronchus. This was easily removed with a pair of alligator forceps. Tracheal canula left in place forty-eight hours, then omitted at intervals. Severe bronchopneumonia followed, but there was no expiratory dyspnea after foreign body was removed.

Richards.

XXX.

THE RESULTS OBTAINED FROM THE RADICAL OPERATION FOR CHRONIC PURULENT OTITIS MEDIA.*

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In accepting the invitation to discuss the subject of this paper, my understanding was that a review of the writer's personal experience was desired, not a critical examination of the literature on the subject. My first thought was to give in tabulated form the more or less complete notes of about two hundred operative cases, but the time allotted to papers will not permit of this lengthy discussion, so we will reserve this for a future paper.

With the possible exception of acute mastoiditis and the indications for operating thereon, no other subject in otological literature has elicited more thorough investigation and discussion by the best intellects in the profession, than that dealing with the various methods at our command to combat successfully the ravages of a chronic suppurating ear. Many of us are familiar with the extensive opposition formerly encountered when the operation under consideration was advised. To this very antagonism, however, we, as well as the public in general, are greatly indebted, for it seems to have acted as a stimulus, irresistible in character, to further the dauntless courage and incessant labors of the few pioneers, who builded even better than they knew.

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*Read at the 12th Annual Meeting of the American Laryngological, Rhinological and Otological Society, Kansas City, Mo., June, 1906.

Enthusiasm, properly directed, is essential for the successful promotion of almost any radical change or advancement. This is true, especially, in its relation to conservative medicine. The enthusiastic advocate of a new surgical problem, therefore, occupies a very important place in the actual advance of medical science, for although this earnestness may carry his measure beyond the line of prudence, or even safety, thus simulating what may be termed frenzied surgery, he will soon be brought to a proper realization of its worth, by running counter to the apathy of the ultra-conservative element of the profession, and all that pertains to its correcting and beneficial influence. It is the middle ground, the compromise that those two extreme elements eventually adopt, that will prevail. The subject of this paper has passed through the various stages above enumerated, and we are now settling down to a well-defined, rational conception of the disease and its remedy.

Not long since, it appeared that our success in curing a chronic discharging ear by means of the radical operation made it incumbent upon us to adopt this method of treatment indiscriminately; more recently, however, a healthy reaction has become quite manifest, and we are again disposed to resort to ossiculectomy and tympanic curettement as an efficient means of relieving suppurating ears of a definite character. Indeed, it is the writer's belief and teaching that the minor operation should first be employed in the large class of cases where mastoid or other intracranial complications are not suspected, or where symptoms do not demand the immediate adoption of more radical measures. On the other hand, however, it must be remembered that a great majority of the serious complications, both intracranial and general, incident to such a condition, arise from the chronic form of disease; moreover, some complications, such as brain abscess, may have actually existed for some months, or even for a period of years, without producing symptoms peculiar to their kind, apparently without cause, or perhaps following slight injury to the head. These abscess formations suddenly give rise to most alarming phenomena, which must always be viewed with grave apprehension, inasmuch as the symptoms are frequently so ill defined as to render a correct diagnosis impossible. No doubt many of us have been subject to the keen mortification of operating on a suspected temporo-sphenoidal or cerebellar abscess without having our diagnosis confirmed by the findings, and yet, all the antemortem symptoms indicating the diagnosis as made were sustained by neurologists and general surgeons of ability, whereas the autopsy revealed the lesion to be located in another part of the brain.

Mention of these facts is made for the purpose of again calling attention to our faulty and misleading methods of determining brain localization in lesions arising from diseases of the organ of hearing. Furthermore, the above will serve to illustrate in a forceful manner the one cardinal point, the chief factor indeed, in dealing with all classes and varieties of pus formation and necrotic changes occurring within the temporal bone, namely, to strive to eradicate the disease by whatever means may be necessary, before any of the more serious complications have time to develop. The discharge of pus from any part of the ear must be regarded as a daily menace to the health and life of the individual so afflicted; this truism is not in any sense modified by knowledge of the fact that cases have been observed to exist for many years without the development of serious complications.

This brings us to a consideration of the best means of treating cases of chronic suppurative otitis media. First, however, it is well that we recall the indications for the radical operation, inasmuch as it is now generally conceded that the more simple method should first be employed in selected cases.

Notwithstanding this fact, however, a thorough and exhaustive analysis of every detail of the subject will establish the unalterable conclusion that the radical operation is the only satisfactory method that can be adopted in the vast majority of cases. This conclusion is so convincing that even the most skeptical and ultra-conservative are ready converts to its utility, when brought in actual contact with the results.

In this connection the writer is forcibly reminded of a certain percentage of cases subjected to the radical operation, in which the discharge does not cease within a reasonable time, or having once stopped, is subject to relapse. At one time these annoying cases were quite numerous, but as the technique of the operation improved, and the deftness and understanding of the surgeon developed, these cases have grown less and less with each succeeding year, so that the necessity for secondary operations has been reduced to a minimum. The chief causes for these relapses were incomplete or faulty operations, especially in relation to undiscovered necrotic cells of the zygoma and the mastoid tip, as well as reinfection occurring from the Eustachian tube; at the present time we would consider these sources of autoinfection mostly preventable. In considering the indications for performing the radical operation, we must not lose sight of the important fact that the attic, the aditus and the antrum are integral parts of the tympanic cavity and usually share in its infections. This fact alone explains why so-called suppurative otitis media cases become chronic and remain so, and furthermore, shows the folly of protracted efforts to relieve a condition that cannot possibly be reached through the external canal. We must earnestly endeavor to impress upon the mind of the profession this one fact of vital importance, namely, that the discharge escaping from the external canal is nothing more than a local manifestation of the necrotic changes occurring within the mastoid antrum and lower cells or the cranial cavity, and that the middle ear cavity and auditory canal through which it passes are important chiefly as a safety valve or means of exit for the overflow pus. In other words, it must be observed that a dense bony wall separates the external canal from the actual site of the disease, the only communication being the narrow opening connecting the tympanic cavity with the mastoid antrum.

In this connection, therefore, we again wish to call attention to the extreme folly of adopting any line of treatment which at best can have little more for its object than cleanliness of the external parts. In no possible way can the cases under consideration receive benefit by the application of such measures, and we should lose no opportunity to effect the proper recognition and conception of these facts.

Broadly speaking, the writer believes it is not only wise, but urgently imperative, to perform the radical operation in all cases that do not yield to the more simple measures within a reasonable time; and as the duration of time in this connection can be applied only in a relative sense, we must, after all, depend on our good judgment in determining the proper time to operate; a sane judgment should develop with experience, with which there is usually associated a peculiar intuition, always more or less difficult of explicit interpretation, but which may be safely followed. From time immemorial, the presence of pus in any part of the economy has been considered the most potent foe of the human race; this is especially true when confined within a cavity, the integrity of which must sooner or later yield to the ever increasing pressure caused by the accumulation of inflammatory debris and the necrotic changes incident thereto. Why these sound surgical principles as applied to a more or less blind cavern as the mastoid process should be viewed with such an unusual sense of apathy, especially when we recall the vital structures immediately adjacent thereto, is difficult to comprehend, except that knowledge of the unusual danger likely to be encountered forbids a prompt acceptance of such responsibility. However, it is just this hesitancy, this procrastination, this putting off until the morrow, that invites additional complications and frequently their fatal termination.

We encounter cases of either acute or chronic suppuration in which a carious fistulous opening eventually penetrates the mastoid cortex, giving rise to periostitis and the classical symptons of mastoiditis. These patients on account of the formidable objective symptoms become alarming to the attending physician, but this ocular manifestation of the disease is decidedly favorable rather than unfavorable, as it indicates that the direction of the inflammation is external rather than internal. It is those cases of tenderness, however slight, on deep pressure, without external evidence of deep-seated mischief, that are of much greater import, indicating as they do that the direction of inflammatory involvement is inward.

As stated in the beginning, the scope of this paper will not embrace a review of literature, of which there is much, worthy of profound consideration, but to these general remarks will be added a few personal observations and conclusions.

The operation in the majority of cases has no detrimental effect upon the hearing. If any change at all is brought about by the operation, it would be for the improvement, rather than impairment, of the function of hearing. On the other hand, however, we must not lose sight of the fact that occasionally we find a case that will be positively made worse by the operation. I have never been able to give any explanation of this fact. Hankins (Australasian Med. Gaz., Vol. 24, 1905, p. 199) says: "I think there is every prospect that before long the results will so improve that it will be justifiable to operate with a view to increasing the hearing power, impaired by long suppuration, which may at the time have ceased." This enthusiastic statement, however, had perhaps better be qualified by the provision that one should determine definitely whether the impairment of hearing in a given case is due to tympanic disease or to labyrinthine involvement. As epidermization progresses we usually find some impairment of hearing, as the skin covers the tympanic cavity, this part being usually the last to be covered.

Injury to the tympanic branch of the facial nerve is not frequently encountered at the present time, owing to the improved technique. However, we find in some cases a facial palsy of mild degree occurring several days after operation. This may be accounted for by the formation of an inflammatory exudate with the Fallopian canal which always disappears within a very short time under the influence of electricity. Other possible injuries, such as injury to the jugular bulb, semi-circular canals and the sigmoid sinus, are all very infrequent occurrences.

A point to which I wish to call particular attention is the frequency with which we find a carious opening through the tympanic roof, which the writer has reason to believe is often overlooked, and inasmuch as it is a source of drainage for an extradural and also a temporo-sphenoidal abscess, the importance of discovering this opening is manifest. It is frequently too small to provide for proper drainage and must necessarily be enlarged. The writer believes this to be one of the frequent causes of prolonged suppuration following the radical operation.

It is most important that both the malleus and incus, and especially the latter, should be removed at the time of operation. On account of the deficiency of nutritive vessels supplying the incus, we are inclined to feel that it has become disintegrated and discharged in the form of pus, but a more careful search will frequently discover it in some portion of the tympanic cavity, and if overlooked must necessarily be the cause of an indefinitely continued discharge.

As regards skin grafting, in the early days of the radical operation, the writer attempted the various methods of skin grafting, but in later years he has abandoned this procedure entirely from the fact that virtually any of the complications following the radical operation have occurred in those cases in which he had attempted skin grafting. The only benefit that can be derived from skin grafting is the questionable claim that it shortens the length of convalescence. However, by following the line of treatment which will be detailed presently, we feel that the results are better and more quickly obtained and that thorough dermatization is accomplished in much less time than when skin grafting was resorted to.

The character of the discharge is a matter of the greatest importance in determining the necessity for immediate operation. A continued foul-smelling secretion always indicates necrotic bone and this in turn requires operative interference. The writer believes that the presence of the pneumococcus, streptococcus or the bacillus of influenza in the discharge, or the presence of cholesteatoma in the ear is an absolute indication for the radical operation, as in his experience these microorganisms have been found either singly or as a mixed infection in practically all of the intracranial complications. He further believes them to be chiefly responsible for the extensive carious involvement of either the middle ear or mastoid.

On account of the obscurity of such cases to the uneducated eye, they are allowed to progress on their deadly mission, day by day, week by week, or month by month, until eventually life is destroyed without the ear, the primary or underlying cause, being suspected. The chief object of the present medical age would seem to be the prevention of disease, but it is not entirely complimentary to a learned profession, vested with the rights and responsibilities of conserving the public health, to manifest such utter disregard for the prophylaxis of certain diseases of the ear. It would not be possible for such unsanitary conditions to prevail in any other branch of surgery, which indeed compare favorably with the discreditable seton age, when a knotted string was pulled through an enlarged gland for the purpose of its dissipation. Modern surgery demands the prompt eradication of pus, necrotic tissue and all other inflammatory debris wherever located; the ear and its accessory cavities can no longer be the one conspicuous exception.

As we now recognize that more than ninety per cent of all brain abscesses are traceable directly to aural disease; that practically all cases of sinus thrombosis are due to the same cause, and upon further reflection are reminded of the numerous cases of meningitis and other serious general ailments that complicate diseases of the ear, it should be our constant aim to convert the widespread apathy that tolerates the existence of so large a number of secondary diseases, many of which are positively preventable.

The limits of this paper will not admit of even touching upon the technique of the operation, except to state that, however perfectly we may execute every surgical detail, our final results will not be that which might reasonably be expected, unless we are prepared to personally conduct the after-treatment; the absence of this personal care will account for many of the slow recoveries.

It may be of interest to relate somewhat in detail the line of post-operative treatment which the writer has followed for some years, by means of which, furthermore, he has secured very satisfactory results. The chief object of this method of treatment consists in keeping the propagatory surface dry, inasmuch as heat and moisture favor the rapid multiplication of microorganisms. The dressing applied at the termination of the operation is not disturbed for a period of from five to seven days, at the end of which time the packing is removed and is not again reinserted. The ear is then syringed with a 25 per cent solution of hydrogen peroxide, then normal salt solution, and this is followed by a 10 per cent solution of alcohol, the latter being gradually increased in strength until absolute alcohol is used. After syringing as above stated, the entire ear cavity is carefully and thoroughly dried under good reflected light, then a powder composed of equal parts of aristol and boric acid is liberally insufflated over the entire cavity; the same powder is also placed over the mastoid incision and the dressing applied. This method of treatment is applied every second day until the discharge has markedly decreased. The frequency of subsequent dressings will be governed by the amount of discharge.

A modification of this line of treatment will consist in cleansing the canal with the above solutions by means of the cotton wrapped applicator in cases where there is only a scanty discharge. This modification is especially applicable to cases after the first two or three weeks, at which time the discharge has greatly decreased.

With this method of treatment it is the exception to find the appearance of exuberant granulation tissue. This is particularly true and worthy of special mention in treating syphilitic and tuberculous cases in which the tendency to granulation tissue is very marked.

XXXI.

THE RESULTS OBTAINED FROM THE RADICAL OPERATION FOR CHRONIC PURULENT OTITIS MEDIA.*

By Edward Bradford Dench, M. D.,
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Owing to the frequency of chronic middle ear suppuration, and the fatal results which so often follow this condition, if it is left uncontrolled, it is no wonder that the radical operation for the cure of chronic middle ear suppuration has been greatly exploited during the past decade. The true value of any surgical procedure can be determined only after the operation in question has been in vogue for a number of years, thus giving an opportunity for the ultimate results following operative interference to be decided upon definitely.

The results obtained by the operation in question, may be considered under the following heads: 1st, the efficiency of the operation in protecting the patient against intracranial suppuration; 2nd, efficiency of the operation in causing a permanent cessation of the otorrhea; 3rd, the immediate and remote effect of the operation upon the function of the organ, and 4th, the effect upon the integrity of the facial nerve.

I have upon my books at the present time records of 193 operations of this character. In none of these patients, so far as I know, has there been any evidence of an intracranial lesion after the suppuration has been relieved. We may say, therefore, that the radical operation certainly does protect the patient from the dangerous sequelae of middle ear suppuration.

When we come to consider the matter of the permanent relief of the otorrhea, the results obtained by this procedure are, perhaps, not as flattering as we had hoped they would be when the procedure was first suggested.

Out of 193 cases, there are 131 cures, 29 with slight discharge, 5 with profuse discharge, 2 still under treatment, 6 fatal cases, and 20 cases in which the result was unknown.

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*Read before American Laryngological, Rhinological and Otological Society, Kansas City, June, 1906.

In going over these results more in detail, if we take out the 20 cases in which the result is unknown, we have 173 cases, of which 131 are cured, or a little over 75 per cent. Out of the last series of 95 cases, the cures amount to exactly 80 per cent, in those cases in which the results are complete. In the last series of cases, in no instance did the discharge remain profuse after the operation, all of the cases being either dry or presenting but a slight discharge from the meatus. Of the 6 deaths, two patients died of pneumonia, two of meningitis, one of cerebral abscess, and one of cerebellar abscess complicated by sarcoma of the auditory nerve. In no instance could death be attributed either directly or indirectly to the operation.

Of those cases which were operated upon several years ago, and which have been followed carefully, the results have been most satisfactory. Even where a small amount of discharge has persisted for weeks or even months after the operation, this discharge has in almost every instance disappeared absolutely, without the necessity of secondary interference, under simple measures of cleanliness.

Even in those cases where the cure has been considered perfect, it is not uncommon to have the patients return, at intervals of from four months to one or two years, complaining of some discharge from the external auditory canal. An examination will show the entire cavity filled with a mass of desquamated epithelium, upon the removal of which a small amount of pus may be found. If this accumulation has remained in the canal for a considerable period of time, desquamation of the epithelial lining of the cavity may have taken place either completely or over certain areas. On removing the epithelial mass, the cavity certainly looks far from healthy, and one unaccustomed to this condition, would certainly say that the radical operation had been a failure. If the cavity is simply sterilized with an alcoholic solution of bichlorid of mercury, and then dusted with some bland, non-irritating powder, such as boric acid, xeroform, zinc oxid, or, in fact, any sterile powder, the cavity immediately becomes dry. In other words, the apparent relapse in so many of these cases is due simply to the fact that the integument lining the middle ear cavity and the mastoid cells, is improperly nourished. This integument forms the lining of a blind pouch where it is subjected to increased temperature, increased moisture, the absence of light, and no circulation of air, these latter conditions being essential to the proper nutrition of the normal skin. Moreover, it must be remembered that this tegumentary lining is applied closely to the bony walls of the cavity, with very little connective tissue substance intervening.

It is not strange, therefore, that desquamation should take place from time to time, in such a cavity, and that the desquamated epithelium, if allowed to remain in position, should gradually accumulate until the cavity becomes completely filled with these epithelial cells. The production of these cast-off cells causes superficial ulceration of the underlying tissue, so that complete desquamation of a cavity of this kind frequently takes place. These attacks of desquamation of the cavity occur less and less frequently as time goes on, because the integument gradually adapts itself to its new habitat, and in the course of time is able to conform itself to its anomalous position.

These attacks of desquamation should not be looked upon as a recurrence of the otitis. As before stated, they are easily relieved by the removal of the epithelial detritus, and the sterilization of the walls of the cavity.

When the radical operation was first proposed, and, I am sorry to say, even at the present time, many surgeons hesitated to advise the procedure for fear of impairing the function of audition, as the result of operative interference. In the series of cases in which I have advised this operation, I can state that in but very few instances has the hearing been made worse by the procedure.

Out of 111 cases, in which the hearing records were kept, the hearing after the operation was good in 99, was fair in 9. and was bad in 3. By "good hearing," I mean hearing where the whispered voice was heard anywhere from 5 feet to 15 feet, and by "fair hearing," where the whispered voice was heard from 6 feet to 3 feet, or 4 feet. In the 3 remaining cases, where the hearing is recorded as "bad," the hearing was worse than before the operation.

If the operator exercises caution in his manipulation, and is careful neither to dislodge the stapes, nor to impact it in the oval window, he can promise the patient almost certainly that the hearing will not be greatly interfered with as the result of the operation. This remark applies to those cases in which the hearing is considerably impaired before the procedure is undertaken. Given, for instance, a case of chronic middle ear suppuration, where the low whisper is heard at a distance of 10 feet, in such a case, impairment of the hearing might follow operation. With a whispering distance of 3 or 4 feet, however, the hearing would hardly become impaired as the result of the operation, while the chances of improvement in the hearing would be considerable.

I have a number of cases at the present time under observation which were subjected to the operation a number of years ago. In these cases, the hearing has steadily improved, owing probably to a gradual mobilization of the stapes by sound waves. In those cases, therefore, where no labyrinthine lesion exists, as evidenced by careful functional examination, and where there is a moderate impairment of hearing prior to operation, the surgeon need not hesitate to advise the procedure for fear of impairing the function of the organ. The hearing is more apt to be improved by the operation than to be impaired by it.

Referring to those unfortunate cases where a partial or a complete facial paralysis results from the operation, either immediately, or where it supervenes at the end of a few days, I can only say that in my own experience, the function of the facial nerve has ultimately been restored in every instance. Out of the last 95 cases operated on, facial paralysis occurred in 4 instances, and in every instance, the function of the facial has been restored.

Of the series of cases previously reported, the exact number of instances in which the facial was involved, is not definitely known. (Transactions of the 7th International Otological Congress, Bordeaux, 1904.) I should say, however, that secondary paralysis occurred in about the same proportion of cases in these two series. In those cases where facial paralysis comes on at the end of two or three days after the operation, the function of the facial nerve is usually restored at the end of two or three weeks, although I have seen several months elapse before power was completely restored to the facial muscles. In those cases, where facial paralysis comes on immediately after the operation, the period before complete recovery takes place is often long. Here six, seven, eight, or even more months may elapse before all evidences of facial paralysis disappear. If, however, the facial nerve is not completely severed at the time of operation, I believe that its function will be entirely restored in the very large proportion of instances.

Where facial paralysis does occur, it is best treated by daily applications of either the galvanic or faradic current, the galvanic being used where the muscles do not react to faradic stimulation. Where the muscles react to faradism, the faradic current is to be used. In addition to the use of electricity, the administration of strychnin internally, seems to hasten the restoration of the function of the nerve.

You will understand that I am speaking now simply from my own statistics, and in no single instance have I seen, in my own cases, permanent facial paralysis follow the operation.

So much for the ultimate results obtained in these cases. Certain questions have come up in regard to the technique of the operation, which may perhaps be discussed here.

First, the advisability of primary grafting.

Second, the advisability of secondary grafting at the end of five to ten days after the primary operation.

Third, the advisability of the introduction of grafts through the canal.

Fourth, anomalous methods of healing after skin grafting.

There is no doubt in my own mind as to the advisability of employing large skin grafts for lining the bony cavity formed during the radical operation. It is true that all of these cases will recover, and will recover quite as well if skin grafting is not employed. From a considerable experience, however, I am absolutely certain that the period of convalescence is shortened if skin grafting is employed, either as a primary procedure or from five to ten days after the original operation.

Out of the last 95 cases, primary grafting was employed forty-eight times. The grafts did not take in every instance, but in at least 75 per cent of the cases the grafts adhered, either in part or throughout. The application of either primary grafts or of secondary grafts certainly shortens the convalescence.

Regarding the advisability of applying grafts through the external auditory meatus, this procedure has been advocated by a number of writers. I have employed this method in but one instance. Here the result was satisfactory, but here also, the external auditory meatus had been very greatly enlarged by means of a plastic operation. I do not think that the application of Thiersch grafts through the external auditory canal is applicable to a very large proportion of cases, and I prefer, therefore, to apply the grafts either at the time of the first operation, or to do a secondary operation for the purpose of grafting the wound through the posterior opening.

As to whether the skin graft is to be inserted at the time of the primary operation, or at a later date, will depend somewhat upon the choice of the operator, and very largely upon the pathologic conditions found at the time of the operation. If the case operated upon is what may be termed an "interval" case, that is, if there are no symptoms of acute suppuration, if there is but little fluid pus in the mastoid antrum and mastoid cells, and if neither the dura or sinus is exposed at the time of the operation, I believe that primary grafting should be the rule. The fact that either the sinus or dura in the middle cranial fossa is exposed at the time of the primary operation, does not necessarily prevent the operator from lining the interior of the cavity with a skin graft, provided the sinus and dura seem normal. Care should be taken, however, that the grafts be applied only to those parts of the middle ear not in the immediate vicinity of the exposed sinus or dura. Where the sinus has been exposed, it is my invariable rule not to close the posterior wound completely, but to insert a small gauze drain over the sinus and bring it out at the inferior angle of the wound. This gauze drain is removed at the first dressing, and may or may not be replaced, according to the condition found. In cases which are particularly foul, that is, where the mastoid cells are found to contain fluid pus, or where the necrosis is extensive, I seldom employ primary grafts. In these cases the posterior wound is not sutured. The plastic operation on the auricle is done, the posterior wound packed and the case dressed first on the third or fourth day. After this time, it is dressed daily until healthy granulations are found lining the entire radical cavity. Any time from five to ten days will be a favorable time for grafting upon these granulations. Of course, after the secondary grafting, the posterior wound is completely sutured.

There is one method of healing which has been observed in a number of cases that have been grafted primarily. In certain instances, it is unwise to apply the grafts over the entire bony cavity, owing either to exposure of the sinus over a limited area or exposure of the dura. In cases where the cavity is partially grafted, and the remainder allowed to heal by granulation, the grafts may become incarcerated in the granulation tissue; that is, if the graft is applied to the fundus of the bony cavity and not to the walls, granulations may spring up from the walls, and for a time almost completely hide the grafted area. As these granulations are controlled, however, the fundus of the canal will gradually appear, and the graft will be found in place and adherent, and the fundus dry.

Another condition which is sometimes met with, is an adhesion between the upper wall of the operation cavity and the facial spur. In cases where the middle cranial fossa lies very low, it is sometimes impossible to prevent this adhesion from forming. On examining the ear we find the radical cavity divided into two parts by a septum or partition, a posterior portion, made up of the mastoid cavity, and an anterior portion comprising the atrium and vault. In some instances, this septum may extend nearly to the meatal opening. We seldom find the ear perfectly dry while this septum is present. If simple cleanliness is observed, however, the septum gradually disappears, and after an interval of from three to nine months after the operation, the entire radical cavity will be found to have resumed its proper form. In one instance, I remember that this septum so obstructed drainage, that it was thought a secondary operation might be necessary. Simple division of the septum and packing the wound with gauze, brought about a complete and permanent cure.

I have attempted to present the results following operation, as clearly and concisely as possible. The paper simply embraces a study of my own cases, and does not deal at all with the experience of others.

DISCUSSION.

Dr. Norval H. Pierce, Chicago, in opening the discussion, said he wished to speak of the changes in audition after operation. He believed that the following tests should always be made before operating: that is, first the whisper test; second, the test for low sounds; third, bone conduction and lateralization, and fourth, Rinné's test. In this way we may ascertain whether there is stapes ankylosis or nerve degeneration. He has been surprised to find how often the auditory nerve is affected in suppurative ear disease; whether this was due to absolute invasion of the labyrinth by the suppurative process, he felt himself unable to say, but when one is sure it has invaded the labyrinth its course is very different. Where there has been no stapes ankylosis and no nerve involvement before operation, the audition has been improved, or unchanged.

Dr. Charles W. Richardson, Washington, said in regard to the operation, that he had had about a half dozen cases of facial paralysis coming on after the operation. All of these cases were now ancient enough to have completely and absolutely recovered. He recalled attention to the fact that he applies no packing after the primary packing has been removed. He thought it one of the most satisfactory operations that he knew of; it gave good results. His results had all been satisfactory. He called attention to a case he had operated upon recently in which a web had been found between the superior wall and the facial ridge. It was let alone and is now gradually disappearing. He had cavities where the granulations nearly filled them up, which latterly become capacious as the cicatrization takes place. Dr. Dench had told him that in his experience webs usually break away and clear up.

Dr. E. M. Holmes, Boston, said more positive results could be obtained in this class of cases than in any other. Regarding the facial nerve, he related one interesting case of a girl of about 35 who had facial paralysis for 13 years. He operated on the mastoid on the right side, and after completing the operation a large chestnut could have been placed in the cavity. The case went along nicely, but the facial paralysis persisted. She returned a month ago with considerable power on that side of the face. Doctor Lund had performed anastomosis between the hypoglossal and facial nerves. Unless she laughs, the paralysis is unnoticeable. Regarding the skin flap, for four years he has been performing an operation in which his first incision is carried through the skin only. It is dissected forward, not injuring the periosteum. The posterior superior portion of the cartilaginous canal is severed near its attachment to the bony canal and the auricle is carried forward. With a small angular knife an incision is carried through the skin and periosteum of the bony canal at about the junction of the superior and anterior quadrants above, and the posterior and inferior quadrants below. Between these an incision is carried just outside the annulus. An incision is also carried through periosteum of the mastoid from the incision of the superior portion of canal backward over the temporal line. From the outer end of the lower incision in the canal the periosteum is incised on a line toward the mastoid tip. The periosteum is carefully elevated from the canal and mastoid, that from the canal is covered by the skin of the canal. The flap of skin and periosteum is rolled back and covered with moist sterile gauze. After the mastoid and middle ear have been exenterated, all rough bone is smoothed so as to leave a gradual slope, and the periosteal-skin flap is adjusted. The auricle is carried to place and fastened with gut sutures. The wound is closed and sutured and a gauze pad applied so as to keep the skin in contact with the periosteum. A tube or wick is inserted in the auditory canal and the usual bandage applied.

Dr. W. C. Phillips, New York, said he would like to discuss three or four points, and the first one was that related to the fatalities following the radical operation for chronic suppuration of the middle ear. The reader of the paper relates six fatalities, and the speaker wished to emphasize the fact that while fatalities were few and may usually have no special connection with the operation, the fact remained that they did ensue. At the Atlantic City meeting two years ago, he had reported two fatalities following the radical operation. It was discussed by a number of men, everyone of whom reported from one to three cases. Since that meeting, two more fatalities had occurred in the speaker's practice; one of them the result of a brain abscess of long standing, which was discovered only at the time of the operation, and which, after evacuation, rapidly developed a general septic meningitis, and the other a case of purulent meningitis, both of which he expected to report in full. The brain abscess was an old one and had no doubt been in a quiescent state for many months. Another question, that of facial paralysis, should not be underestimated. From what he had seen and heard, facial paralysis, usually temporary, occurs more frequently than is ever read of in the journals. While it may be but temporary, it is annoying during the months it remains. He had been very fortunate himself in this regard, and attributed it to the experience he had gained in teaching the radical and other operations upon the cadaver for so many years. For the past two or three years he did not recall a case, aside from two which came on from pressure of packing and were but temporary. Regarding the anastomosis of the facial and hypoglossal, it had been done, but the procedure was not yet proven to be of much benefit. Regarding skin grafting, the speaker noted that Dr. Dench was still enthusiastic, but that he was one of the few in New York City who had much confidence in it and its results. The speaker has practically abandoned it, and is able to get better results without it than by its use. He thought there were several objections to it, chiefly that it required the patient to submit to a second operation.

Dr. Kaspar Pischel, San Francisco, said that some patients returned thinking that the operation had done no good; but it is well known that it is but the breaking down of the poorly nourished integument. He has devised a flap which will furnish a good skin and will allow the wound to close immediately. (Published in the *Archives of Otology,* Vol. XXX, No. 2, 1901.) The doctor demonstrated his procedure.

Dr. E. B. Dench, closing the discussion, said he had performed a radical operation, found the facial nerve and exposed it for three-quarters of an inch. When it was picked up there was no response to mechanical stimulus. Two years later the patient had perfect control. Provided there is no division, there is no limit as to time when functions may be restored. He thought Dr. Richardson's idea of introducing no packing after the primary packing had been removed, was exceedingly good. He was much interested in the periosteal flap mentioned by Dr. Holmes, and what Dr. Phillips said regarding fatalities was also true. There are a good many cases quite serious when they come under operation. They have chronic suppuration dating back for years and have been suffering perhaps from intracranial infection, prior to operation. He thought that in a certain proportion of these cases a meningitis or brain abscess may be lighted up. On the other hand, at autopsies, brain abscess cavities are found absolutely sterile. If the slightest infection is introduced a brain abscess may be verified. Out of 95 cases there were only four cases of paralysis. He was also in accord with what Dr. Phillips said regarding skin graft. He also finds it difficult to anesthetize a second time, though if the patient is told it is to be done in two stages, it may be performed. He thought Dr. Pischel's flap a very good one. All these wounds are closed at the time of operation.

XXXII.

OCULAR SYMPTOMS OF NASAL ORIGIN—REPORT OF A CASE OF RETROBULBAR NEURITIS AND OTHER ILLUSTRATIVE CASES.*

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The comparatively recent studies of the accessory sinuses of the nose (notably those of Onodi, Killian, Hajek, Logan Turner, Cryer, Lothrop and Mosher) and the pathologic findings, largely the result of surgical interference in suppuration of these sinuses, have caused widespread interest in this field of surgical work. The accumulation of clinical experience in this region has increased with the rapidly spreading search to discover the seat of suppuration in cases of so-called "nasal catarrh." One result of this searching inquiry into nasal suppuration has been a partial realignment of the recently more or less disassociated specialties of ophthalmology and rhinology, in so far as greater attention is being paid to the causal connection between certain ocular symptoms and suppuration in the adjacent accessory sinuses of the nose. Aside from orbital abscesses that plainly point to the frontal sinus or anterior ethmoidal cells as the primary cause, there are other ocular symptoms resulting from disease of the deeper sinuses, namely, the posterior ethmoidal and sphenoid cells, which often cannot so easily be traced to their true source.

The association of the nervous and vascular supply to the eye and nose is readily seen by such common symptoms as the congestion of the conjunctiva in an ordinary "cold in the head," or conversely, the sneezing that often results from looking at the sun, explained through the nasal reflex from irritation of the ciliary nerves of the eye. Again, the frontal headache, eye-ache and tired feeling resulting from use of the eyes during an acute coryza are commonly noted symptoms. That these ocular symptoms result reflexly from disturbances of the circulation in the acutely inflamed accessory sinuses of the nose seems evident from the aggravation of the same symptoms, even to the production of edema of the eyelids and severe pain in the eyes when the nasal trouble is more severe. It is immaterial whether the ocular symptoms result from actual obstruction in the anastomotic circulation between the eye and nose (as in the anterior and posterior ethmoidal vessels); or from a reflex through the fifth nerve to the sympathetic nerves which have vaso-motor control of the circulation of both the eye and the nose. The point that is meant to be emphasized is, that it is a generally accepted fact that certain ocular symptoms arise apparently reflexly from acute inflammation of the accessory sinuses.

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If this is true in acute inflamamtion, it is equally true in chronic inflammation of these cavities. Here, as in the acute conditions, we may find orbital abscesses pointing to the associated chronic nasal suppuration when there has been a perforation by necrosis of the orbital wall of some inflamed accessory sinus. But also, as in the acute condition, we may find ocular symptoms other than abscess formation dependent upon chronic suppuration when no perforation has occurred. That these ocular symptoms are often not traced to their true source seems reasonable when it is considered how obscure are many cases of chronic suppuration in the deeper accessory sinuses, and how unlikely is the patient seeking relief from such a symptom as eye-ache to mention a "nasal catarrh" that he has had for years and never expects to be rid of.

Aside from the congestion of the mucous membrane lining these cavities, we have in chronic suppuration an additional cause for the reflex eye symptoms, namely, the overdistension of the sinus with pus. This may result from blocking of the small orifice of the sinus with a polyp or from swelling of the mucous membrane. That the obstruction is often but temporary in these chronic cases and recurs only on acute exacerbation of the inflammation is seen by the recurrence of the ocular symptoms when there is an aggravation of the "nasal catarrh." It is of course well recognized that there are many cases of accessory sinus suppuration in which drainage is always good and obstruction never occurs sufficiently to cause symptoms. Artificially, as it were, the same symptoms complained of by the patient are sometimes produced by irritation of the accessory sinuses, when from the filling of the cavities with solution sufficient pressure or irritation occur.

The ocular conditions (other than orbital abscesses) most frequently met with that can be traced to nasal trouble may be enumerated as follows:

(1) *Edema of the Eyelids.* Frontal sinus suppuration should be suspected with or without perforation of its orbital wall, especially when the edema is unilateral. Where no perforation exists, the edema may result from obstruction to the venous circulation through inflammatory swelling of the muco-periosteal lining of the sinus. On securing good drainage through the naso-frontal duct in such cases, the edema quickly subsides. In acute cases, as is well known, shrinking of the mucosa of the middle meatus by cocain-adrenalin often opens up the naso-frontal duct, secures good drainage and relieves the symptoms.

(2) *Congestion of the Conjunctiva.* This symptom has been explained above as due either to actual venous obstruction or, and I think more correctly, as a vaso-motor disturbance reflexly produced through the fifth nerve. In this sense it is a nervous symptom and is met with in suppuration in any of the nasal accessory sinuses, as for instance, from the sphenoid alone.

(3) *Ptosis* (often slight). When ptosis is unilateral and is associated with "nasal catarrh," frontal sinus suppuration is to be suspected, on acount of the close anatomic relation of its lower wall to the levator palpebrae superioris muscle. The ptosis, however, is likely due to a paresis of the nerve filament to the muscle rather than due to an actual immobilization of the muscle through direct extension of the frontal sinus suppuration. (Case No. 1.)

(4) *Squint.* This is more likely due to a perforation of the orbital wall of the frontal or anterior ethmoidal cells with a formation of an orbital abscess and involvement of the muscles. In case No. 5, hereinafter reported, the muscular involvement apparently followed perforation of the antrum into the orbit. Posey states (Journal of the A. M. A., July, 1905): "I am of the opinion that if many of the cases of palsy of extra-

ocular muscles attributed to rheumatism were analyzed, an affection of the sinus would be found to be the underlying cause in many instances."

(5) *Pain in the Eye,* varying in intensity from slight eye-ache to very severe deep-seated pains in the eye and head, often unilateral and aggravated on use of the eye, points to disease of any of the accessory sinuses as a possible cause. It may be due to disease of the sphenoid alone (Case No. 2), in which event the pain is often described as "dragging pain in the eye" or "deep behind the eye" and may be accompanied by severe headaches lasting several days. In other cases "an aching and tired feeling in the eye" may be the only complaint. It is possibly true that many patients are refracted for eye-ache without relief because the seat of trouble in the nose was not found and treated. This is not at all improbable when we realize the great difficulty in diagnosis, especially when the sphenoid cavity alone is involved. (Case No. 3 is one in point.)

(6) *Disturbances of Vision* of nasal origin, due to suppuration in the posterior ethmoid cell or sphenoid cavity. The causal relation of disease of these cavities to disturbances of vision was thoroughly worked out by Onodi (Br. Med. Jour., Nov. 5, 1904,) by anatomic demonstrations and a searching review of the cases that have been reported. Onodi and others have shown that the inner wall of the optic canal, frequently formed by the posterior ethmoid cell or sphenoid cavity, is often thin as paper and occasionally shows dehiscences, so that an extension of the inflammation within either cavity to the optic nerve is easily possible. A retrobulbar neuritis may thus occur, resulting in atrophy of a part or all of the optic nerve and corresponding blindness. (Case No. 5 is one in point.) While this is doubtless rare, Onodi has been able to collect numerous cases. Temporary disturbances of vision are said to be more frequent; Posey ("The Ocular Symptoms of Affections of the Accessory Sinuses of the Nose," *Journal A. M. A.*, Sept. 9th '05) states that "edematous infiltration of the nerve is common. Although the change wrought in the nerve is but slight and the symptoms which it excites are not striking, they must be searched for with care."

Aside from these ocular symptoms, which are likely much less rare than is generally believed, numerous ocular conditions are ascribed to nasal sinus suppuration, the causal connection possibly in some being far fetched. They have not been observed by the writer, nor would they likely be found by those of us who are not engaged in ophthalmologic work. Thus Posey in his instructive paper, referred to above, states that "Zeim, Fromaget, Fish and others have recorded a number of cases of uveitis due to sinusitis, and claim to have seen marked improvement in cases of this nature," also that "Zeim claims that cataracts may be occasioned by diseases of the sinuses"; that Kuhnt has frequently seen "spoke-like opacities of the posterior cortical layer in antral diseases," and that Batten-Fish considers sinusitis to be an "etiological factor in myopia."

Deaths from nasal sinus suppuration are very rare, and therefore opportunity seldom occurs for post-mortem examination of the diseased sinuses of patients who have suffered from associated ocular symptoms. Hence it is necessary all the more to depend on painstaking and often-repeated nasal examinations, if we wish to clear up a certain percentage of obscure ocular symptoms. Furthermore, now that the ophthalmologists have found it necessary to confine their study more and more to the eye, it is incumbent upon those of us who are not doing eye work to keep ourselves and them fully alive to the progress that is being made in this line.

It is hoped that the report of the following cases of chronic suppuration, which with the exception of the case of retrobulbar neuritis are by no means rare, may contribute if only in a small way to the interest in this phase of the subject:

CASE 1.—*Ptosis of the Left Eyelid—Left Frontal, Antrum and Ethmoid Involved.*

Mrs. K—, age 26, was referred Jan. 7, '05, on account of "nasal catarrh" and pain in the left frontal region. She had had nasal discharge for years and a musty odor had been noticed, chiefly by her husband. No other symptoms were remarked until three months ago, when some dull pain and soreness of the left eye and drooping of the left eye-lid appeared. These symptoms had persisted although never severe. She was operated on four years ago, "a bone" being removed from the left side of nose. Otherwise she had had no treatment, except the routine use of a nasal douche. She came to California seven years before and believes some drying up of the nasal discharge followed.

Pus was found on the left side of the nose, in the middle meatus and on the floor. The anterior end of the middle turbinate had been removed and a scab was found adherent to the stump. On wiping this away the middle turbinate was found to be polypoid and pus slowly dripped down from the region of the naso-frontal duct. A cotton-wound applicator passed up rather easily into the frontal sinus, and was followed by a catheter. Some muco-pus was washed out. At a later sitting, the polypoid turbinate was removed and also several clear polyps. Diseased anterior ethmoid cells were removed little by little. Later the antrum was catheterized apparently through the natural opening and muco-pus washed out. The character of the antral secretion was in size and consistency like that of a large pulpy grape with some stringy mucus. A musty odor was apparent, especially on the first irrigation of the antrum and thereafter if the antrum was not irrigated for a week or ten days. There was never any foul-smelling cheesy detritus. After lavage of the cavities, attempts at drying were made by cotton applicators and by having the patient blow the nose with the head inclined to the opposite side. The right side of the nose was apparently not affected. After irrigating the frontal, a marked increase in the ptosis was apparent for a few hours. After four months' treatment, the pain and soreness passed off and the ptosis became barely perceptible. Several months later, the patient was quite comfortable, although she occasionally had a little soreness and a slight drooping of the eyelid, especially when she had a cold. The discharge had not been so bad nor so objectionable as formerly.

CASE 2.—*Dull Pain in the Right Eye—The Right Sphenoid Involved.*

Miss K—, age 21, sought treatment Jan., 1905, for "nasal catarrh," "dragging pain" in the right eye and some congestion of the conjunctiva. (It was an interesting fact that the causal connection between the eye-ache and the nasal trouble was suspected by the patient for the first time on account of a short lecture given to a class of nurses, of which she was a member.)

The patient came to California three months before seeking treatment, largely on acount of the "nasal catarrh." The discharge began six or eight years before, had been constant from in front and behind, but only on the right side. She was quite sure on this point. It was aggravated by a cold. Never any frontal pain or soreness, but dragging pain deep in the right eye had been more or less constant for three or four years and was worse when she had a cold. Of late it was increased on using her eyes, to such an extent that it was interfering with her studies. She was refracted about four years ago and had worn glasses for awhile without relief. No special nasal treatment had been given.

Examination negative; the nose was clean; there was no sign of sinus suppuration. The patient was advised to consult an oculist and to return if she felt an accumulation of discharge in the nose. A few days later she returned, saying she wished to prove that she was not a case of too active an imagination. Muco-pus was found on the floor of the right side of the nose, far back, and on shrinking the middle turbinate, a streak of muco-pus was seen coming from the region of the sphenoid ostium. There was no pus in the middle meatus and none in the left nasal cavity. The right antrum was punctured and irrigated to exclude that cavity, and to a certain extent to exclude the anterior cells above it. No pus was found. The middle turbinate was subsequently partially removed and the sphenoid ostium could be plainly seen with pus coming from it. Thereafter the ostium was enlarged and the sphenoid cavity regularly irrigated and as thoroughly dried as possible. On March 18 (in two months) the patient stated that the eye-ache had been absent for three weeks, and on June 1st that the eye had remained free of pain or aching even on reading—a relief not experienced for a year. She had not been refracted as requested. The discharge gradually decreased and by July 1st it had ceased. She felt cured. Two months later she again reported that she had remained well, and had done nothing in the way of treatment. She now was free of discharge and had not been sprayed or douched in two months. One month later, after "taking cold," the patient returned very much discouraged on account of the reappearance of the same troublesome symptoms, including the eye-ache, in spite of the fact that she had been refracted and glasses fitted. Several "gobs" of muco-pus were washed out of the sphenoid. The discharge gradually ceased again and the eye-ache and congestion entirely subsided in two or three weeks. On Jan. 5, '06 (about 11 months after the first opening and irrigation of the sphenoid), the patient reported that she had had no discharge and no eye-ache since the last rather evanescent attack from the "cold," and except at this time she had had no treatment in six months. On April 1st, '06, she again reported herself as entirely cured. She was advised to report whenever she had a coryza.

In this case the causal connection between the ocular symptoms and the sphenoid trouble was most noteworthy. Additional evidence was furnished by the reappearance of the symptoms in the right eye on the recurrence of the inflammation of the sinus during a coryza, even after the correction of the eyes. The case demonstrated two other points: 1st—The difficulty of diagnosticating suppuration of the sphenoid alone, which may easily be mistaken for post-nasal catarrh. 2nd—The apparent cure of a chronic sinusitis of many years' duration by means of repeatedly irrigating and drying the cavity—a fact, of course, well corroborated in the experience of others.

CASE 3.—*Eye-ache and Frequent Headaches from Sphenoidal Suppuration.*

Miss M—, age 30, referred Dec. 5th, '05, on account of nasal discharge of five years' duration, chiefly from behind. Used six or eight handkerchiefs a day, and had to leave the table almost every day on account of the post-nasal discharge. Every week or two, had severe aching in the eyes, at first only in the left eye, radiating to the ear, now more in the right eye; described as "deep behind the eye," never over the eye, and almost always ending in a severe headache. These attacks had persisted for ten years, and no relief had been found except the temporary relief from antikamnia, with which she keeps well supplied, and of which she claims to have taken 20 grains per day. She has been refracted six or seven times. She was treated for her nasal catarrh for several years without relief and came to California on account of the trouble. Four years ago, she was operated on by Dr. Bolton of Pasedena, to whom the writer is indebted for referring the case, and since then there had been considerable improvement. At the time of her operation, she was told that her trouble was in the accessory sinuses of the nose. The middle turbinate and much of the ethmoid labyrinth had been removed on both sides and the left sphenoid cavity was opened and repeatedly irrigated. She had lately been advised by Dr. Bolton that he suspected renewed inflammation and possibly suppuration in the right sphenoid cavity, as the discharge had again increased. He referred the case on account of illness.

On examination it was seen that the inferior and middle turbinates had been partially removed, exposing the anterior surface of the sphenoid. The left ostium was plainly seen, and evidently had been enlarged. The cavity seemed dry. The right sphenoidal ostium could not be seen or felt, some bands of scar-tissue interfering. No pus appeared in the front of the nose on either side. Stringy muco-pus was seen clinging to the posterior naso-pharyngeal wall; its removal caused come gagging. The findings were thus not conclusive of present sinus involvement. Instead, a chronic post-nasal catarrh was regarded as the cause. At a later examination drops of pus appeared in the sphenoid-ethmoid niche on the right side. On removing some bands of scar-tissue in this locality, the sphenoid ostium came into view, and muco-pus was plainly seen coming from this cavity. The ostium was enlarged and the sphenoid regularly irrigated and dried. Still later, a fistula through the sphenoidal septum was found, proven by the introduction and touching together of two probes, one in each sphenoid cavity. Still later the adjacent posterior ethmoid cells were found diseased.

On Jan. 18th patient stated she had marked relief both in the decrease of the discharge and in the absence of eye-ache and headache; that she had gone over a month without headache, other than some headache on the night following the operation to enlarge the ostium—a relief not experienced in years and now had but little discharge and seldom the objectionable gagging attempts at its removal. The patient is still under treatment, April 1st, '06. The discharge has decreased, but not entirely ceased. The headaches, however, have never recurred.

Case 4.—*Neuralgic Pains in Eyes and Headaches—Chronic Suppuration of Nasal Accessory Sinuses of Both Sides, Associated with Atrophic Rhinitis.*

Miss B—, age 18, treatment sought Sept. 5th, '05, on account of "catarrh." Onset five or six years ago; remembered when the nasal discharge began, but not ascribed to any particular disease; in the beginning had severe pains over the eyes, occurring from time to time and requiring medicine to give relief. The discharge has been constant, worse on right side, mostly from in front, with some odor, if the nostrils are not daily cleaned out, and worse when she had a "cold." No other symptoms except the dull frontal headaches.

Stringy muco-pus was found on both sides, in the middle and superior meatuses. The turbinates are moderately atrophied; pus is seen coming from the region of the naso-frontal duct on each side after being swabbed off; it reappears on blowing the nose. The nasal surface of the right sphenoid is seen to be covered with thick, red mucous membrane streaked with muco-pus. The ostium could not be seen until the mucous membrane had been well shrunken with cocain-adrenalin, when a dimple was apparent. A probe was introduced into this depression and dropped into the cavity; on its withdrawal a few drops of thick pus at once oozed out, a drop at a time, as fast as mopped away.

Operative treatment was advised and refused. Patient returned two months later, Nov. 6th, with complaint of pains over both eyes, and dull headache for a week. The same conditions were seen as at the previous nasal examination.

The right middle turbinate and much of the ethmoid labyrinth were removed and the ostium of the sphenoid enlarged. The patient is still under treatment (April 1st, '06,) and is much improved, claiming that she uses but one handkerchief a day, against the use of four or five, and that there has been marked relief from the headache.

CASE 5.—*Retrobulbar Neuritis, Resulting in Central Scotoma from Suppuration in the Posterior Ethmoidal Cells.*

The extensive involvement of the nasal accessory sinuses confined to one side and the unfortunate result, namely, partial blindness in one eye, and facial deformity, prompts the report of this case in some detail.

C. G., age 46, sought treatment Sept. 12th, '05, in the Ear, Nose and Throat Clinic of the Med. Dept. of the Univ. of Southern California. He had had constant "nasal catarrh" since a boy of 12 or 13 years of age, always from the right side of the nose and accompanied in the beginning by more or less pain in the head and right eye. When about 16 or 17 the trouble "came to a head." The whole right side of the face and head pained severely for many days. He remembered particularly the pain deep in the right eye, which felt as if the eye was being forced out. The right cheek began to swell and pain as if with the mumps. There was no swelling of or above the eyebrow. The painful swelling of the face was below the eye, but the eyelid puffed out somewhat. After several days of suffering an operation was attempted. He was taken to a Brooklyn hospital and a preliminary operation (tracheotomy) was done, but further operation was abandoned on account of the patient's bad condition. His life was despaired of. The cheek abscess finally broke; marked relief from pain followed; foul-smelling pus escaped for several weeks through the cheek. The fistula finally healed but the cheek bone remains thick, hard and prominent to the present time. The nasal discharge had also persisted, but no more bad symptoms had arisen. He dated and attributed the eye trouble to the abscess inside of the cheek. He remembered that his vision was perfect up to that attack and that he was blind thereafter; that he could not count the fingers of his hand when held before his eye, and that all objects looked hazy. Gradually the eyesight improved somewhat. When he looks directly at an object he cannot distinguish it, but must look a little to one side of it. Also, he remembered that his right eyeball did not move well for a long time after the attack and still is sluggish in its movements.

Examination.—Marked disfigurement of the right side of the face. The malar region of the right side measures transversely 2 cm. more than that of the left. The nasal process of the right superior maxillary bone shares in the thickening. There is a small scar under the lower border of the malar bone, at the site of the fistula; also a scar of the neck from the tracheotomy wound. The alveolar process of the right side shows a prominent ridge from the second bicuspid tooth upward, with the alveolar mucous membrane firmly adherent (he remembers that the abscess also discharged into the mouth in this locality). The right nasal cavity is almost completely blocked up with tough, red polyps covered with crusts and pus. The septum is greatly deflected, almost completely blocking the left side of the nose, which is otherwise apparently normal. Posteriorly, the right choana was fairly well blocked up with a firm red polyp.

On removing several polyps from the right side of the nose, the view of the interior looked as if the septum were entirely gone, so great is the deflection. The inferior turbinate was seen to be hypertrophied, the upper part of the nose was full of polyps and crusts covered with pus. On removing these the antral wall was seen to be soft and showed several perforations through which pus escaped. The whole of the nasal wall of the right antrum was removed, exposing a large antrum full of polyps and pus. This was easily accomplished without an external operation, due to the septal deflection and the complete absorption of the bony part of the antral wall. In fact, the nasal wall of the antrum consisted of greatly thickened mucous membrane. The antrum was cleaned out and dried. Its walls were covered with thickened muco-periosteum and no necrosed bone could be seen or felt. Later the remains of the middle turbinate and the ethmoid labyrinth were removed. The bony cell walls had also been absorbed, leaving a grumous mass of hypertrophied mucous membrane, polyps and pus, On cleaning this away, the naso-frontal duct was plainly seen, and a large frontal sinus explored. The frontal sinus was empty and its mucous membrane felt smooth and fairly thin. Posteriorly, above and behind the sphenoid a large irregular cavity presented after removal of several polyps, evidently a large posterior ethmoidal cell. This cavity was somewhat larger than the terminal phalanx of the middle finger, extending backwards to a point 9 cm. from the anterior nasal spine, and overlapped the sphenoid cell. It was lined with thin, pale, muco-periosteum. The sphenoid ostium was seen to be about 1.5 cm. above the upper limit of the posterior choana; a probe passed in about 2 cm. into a small, shallow, empty sphenoidal cavity.

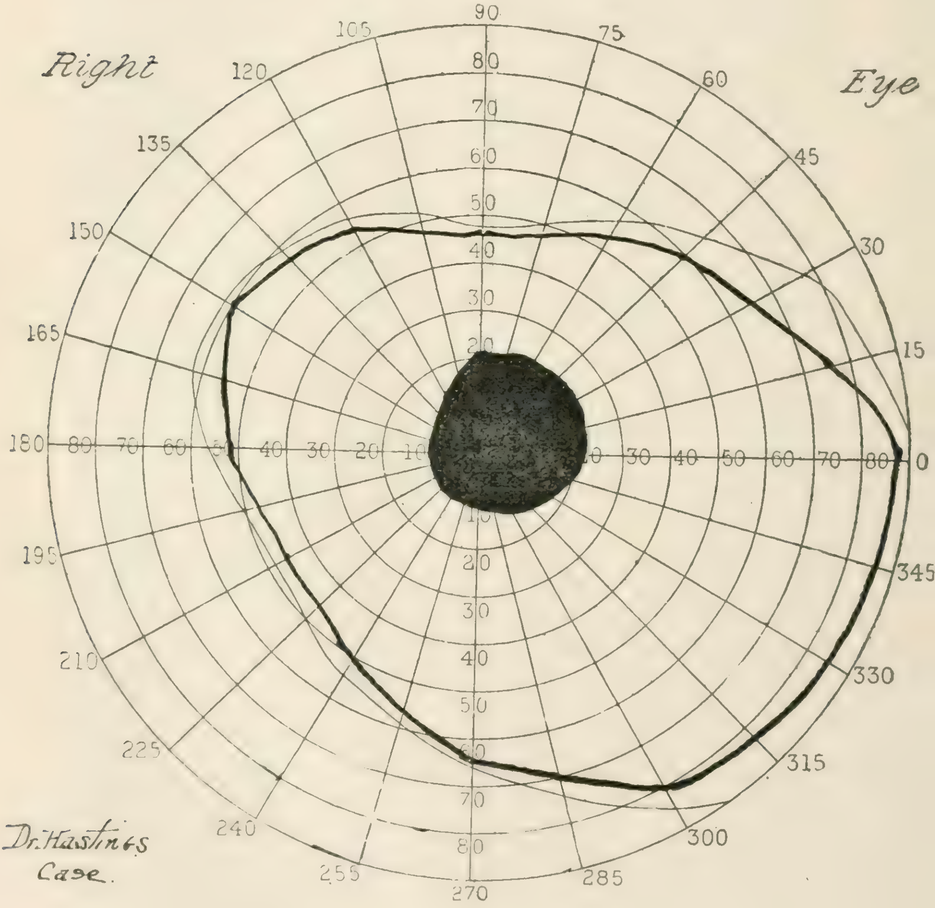
At present, Feb. 1st, '06, the intranasal examination shows that the antrum, large posterior ethmoidal cavity, and the right nasal chamber form one large cavity, into which opens above the naso-frontal duct (6.5 cm. from the anterior nasal spine) and behind the small sphenoidal ostium.

The following measurements of this combined cavity were made by use of graduated probes and are very nearly correct:

(1.) Maxillary Antrum: Height 3 cm., width 3 cm., depth 3 cm. The outer angle of the antrum is 6 cm. from the nasal septum, making an unusually wide nasal cavity.

(2.) Posterior Ethmoid Cell: Height 1.7 cm., width 1.7 cm., depth 2.5 cm. Its posterior wall is 9 cm. from the anterior nasal spine.

(3.) The sphenoid ostium is small, 7.25 cm. from the anterior nasal spine, and a probe can be introduced through it to a depth of 2.25 cm. The cavity seems to be shallow and empty; no pus has been seen coming from it.



It is difficult to say which sinus was the cause of the retrobulbar neuritis. The history of the violent attack of inflammation followed by rupture of the anterior wall of the antrum, apparently through the canine fossa, points to this cavity as an orbital abscess may have occurred simultaneously. However, the patient states quite positively that the swelling was below the orbit, and that there was no redness or swelling of the eye and no bulging of the eye-ball, all of which would be expected in an orbital abscess of the size indicated by his history. Also, an orbital fistula would have more likely resulted.

The presumptive evidence, therefore, points more strongly to the suppurative inflammation in the ethmoid labyrinth, which must have been most severe. The size and position of the posterior ethmoid cell indicates that in this case it likely enters into the formation of the optic foramen as demonstrated by Onodi. In such cases, Onodi states that the septum between the nerve and the cell is always as "thin as the thinnest paper." Inflammation of the nerve would in this case easily occur during the severely acute attack. In fact, it is difficult to see how the nerve would have escaped being affected.

I am greatly indebted to Dr. W. D. Dilworth, who was interested in the case, for the following report of the eye condition:

Right Eye. Direct central vision, zero. When eye is directed 25 to 30 deg. either above or below, to the right or left, of the type, he has 2-60 vision, which lenses do not improve. External appearance, normal; extrinsic muscles act normally. Reaction of pupil, normal; lens and media are clear; fundus normal, except for atrophy of fibers of the temporal segment of the optic disc. Form field, normal. Absolute central scotoma (see chart), extending from 10 deg. nasal to 22 deg. temporal, and from 20 deg. superiorly to 12 deg. inferiorly. Perception for colors is so poor that color field cannot be recorded. Diagnosis: Retrobulbar atrophy.

Left Eye. Normal, except for refractive error. When corrected vision is 6-6.

XXXIII.

HERPES ZOSTER AURIS.

By Derrick T. Vail, M. D.,

CINCINNATI.

Herpes zoster auris, or herpes zoster auricularis, is, judging from the meager reports found in literature, one of the rarest of diseases. A careful search through the Index Medicus and other sources at my command shows scarcely anything presented to the profession in America on this subject since Green's paper published in the Transactions of the American Otological Society in 1874. Prof. Gruber saw only five cases among twenty thousand aural cases of all kinds. The text books recognize the disease, but few authors mention any cases of their own. Politzer gives a page on the subject; Barr gives four lines; Buck, twelve lines; Roosa does not mention it. Dench gives two pages excellently describing the disease; Burnett gives three and a half pages and explains the disease fully; the American Text-Book of Diseases of the Eye, Ear, Nose and Throat, has three lines by one writer, four lines by another, and two lines by a third on the subject; Posey and Wright on the "Ear, Nose and Throat," give seven lines.

By herpes zoster auris we do not refer to the occurrence of a bleb or two, not uncommonly seen accompanying a severe suppurative inflammation of the deeper structures, but to the idiopathic form which starts as herpes and ends as herpes, presenting pain and the characteristic eruption as prominent symptoms and an uncomplicated picture of herpes.

Case Report.—J. W., age 29, toolmaker by trade, a robust, well-nourished male, enjoying unusually good health, and presenting no striking evidence of a neuropathic predisposition, with a negative family history as regards nervous disorders, a negative personal history as regards the same, consulted me on February 24, 1902.

Present History.—Two days ago he came out of his workshop in an overheated state and stood twenty minutes in a cold wind waiting for a street car. Next morning he noticed his right ear was stopped up, accompanied by slight twinges of pain in this ear. At 10:30 o'clock the following night, he had sudden severe pain in the ear, and at 1:30 a. m. the pain had increased to an unbearable agony. He dressed himself and walked a few squares to my residence, ringing me up. When I saw him he was holding his hand to his ear and rocking back and forth with pain. I naturally inferred that he was suffering from an acute attack of otitis media.

Examination revealed a normal drum membrane, but on the posterior wall of the auditory canal close to the membrana tympani was seen a large bleb slightly dark in color as if it contained serum and a small amount of blood. The probe test showed that the bleb was raised epithelium and contained fluid. Cocain and adrenalin were used and the blister incised, a painless procedure, evacuating a quantity of blood-stained serum. The pain was not relieved in the least. Further examination revealed an exquisitely sensitive mastoid. Temperature 98; pulse 72. Thinking that there must be some middle ear involvement, the canal was thoroughly sterilized and the membrana tympani incised at the lower posterior attachment to the annulus, a distance of 8 mm. No fluid presented and the canal was carefully plugged, and the patient sent home supplied with four quarter-grain morphin tablets with the instruction to take one and repeat in an hour or two if not relieved.

Next morning, February 25th, the patient's condition was unchanged excepting that he was worn out with pain, which had been unremitting. He had not slept at all—had taken the morphin tablets hourly without relief, the only effect being that they produced drowsiness. Temperature 98; pulse 72. The patient fainted while attempting to walk across the room. The auditory canal was dry, the membrana tympani injected along the line of incision, but no secretion was present. His pain was deep in the ear and over the mastoid. The mastoid region was very tender but not reddened.

Evening of February 25th.—Pain has lasted all day. Prescribed 15 grains trional to take at 10 p. m. and a saline purge ordered. The auditory canal was plugged with cotton, and the ear and side of the head were confined under a large mass of cotton with a roller bandage.

February 26th.—Patient slept some after taking the trional; feels weak and complains continually of deep-seated pain in the ear and in the mastoid region. Has an ashen color and an anxious expression. Inspection shows a crop of ten vesicles over the tip of the mastoid and just below on the side of the neck, the lowest being the largest. The auditory canal is dry and the bleb on the posterior wall is drying up. The incision in the membrana tympani has healed. The posterior wall of the auditory canal is sensitive to touch, as is also the skin over the mastoid. Ordered salol gr. x, phenacetin gr. v, three hourly.

Evening of February 26th.—Pain less severe. The large blebs over the tip of the mastoid have coalesced and recent smaller ones are seen. Temperature 99.

February 29th.—Permitted to come to town in order to have a photograph taken of the ear. The appearance at that time is as shown in the photograph here presented. Feels weak and nervous, and complains of the pain.

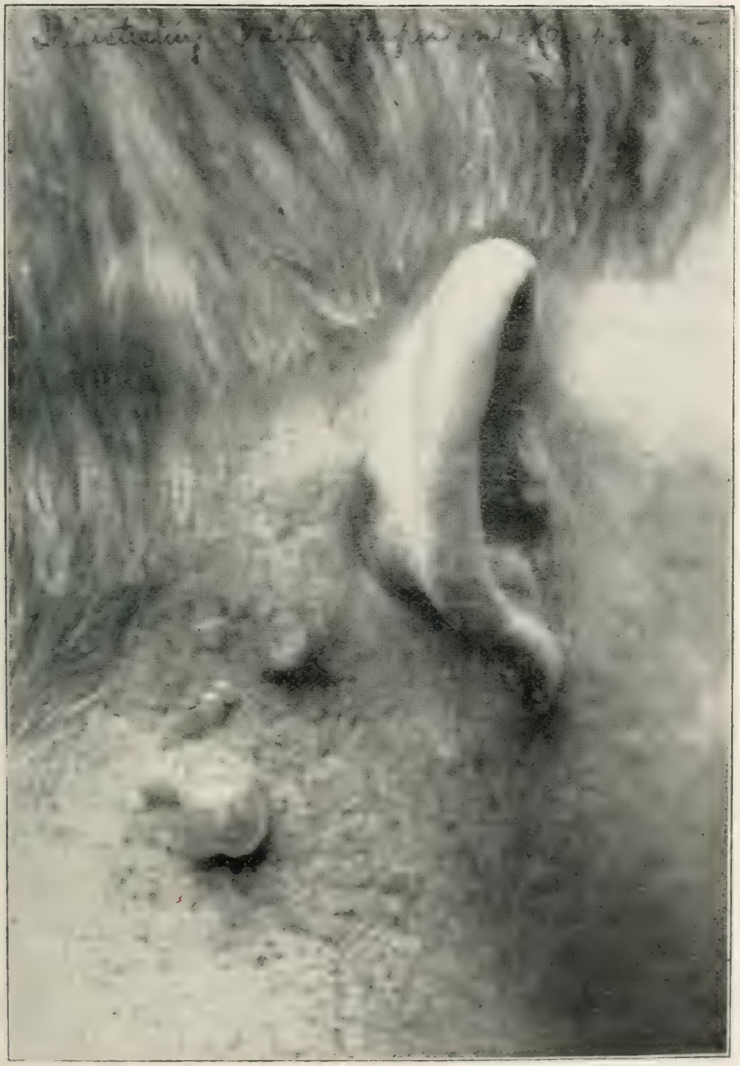
March 1st.—Still has some pain, but is improving. The hearing is improving. The vesicles are smaller and wrinkled; the contents like thickened serum. Air enters the middle ear with a dry sound.

March 8th.—No sloughing. The eruption has dried up and a new scarf skin has formed under the dried eruption. There is paresthesia of the parts, but pain is no longer present. Patient feels well, hearing normal.

Three years later.—No return of symptoms.

An excellent description of the disease is to be found in Burnett's "Treatise on the Ear." He denominates the affection "Idiopathic Herpes Zoster Auricularis," and states that it is a distinct disease of its own class. His description, and, in fact, the description to be found in all sources available to me, mentions the eruption as occurring on the auricle itself, either the front aspect due to involvement of the auriculotemporal, a branch of the trigeminus, or on the posterior surface of the auricle, due to an involvement of the auricularis magnus, a branch of the third cervical.

Gruber has observed herpes of the auditory canal and membrana tympani accompanied by great pain and deafness, and states that he has no doubt that the herpetic eruption occurs in the mucous membrane of the middle ear, basing his supposition on the fact that it has been noticed on other mucous surfaces, notably the soft palate. Hartman, also, has observed the eruption on the membrana tympani.



In Dench's admirable text-book on the ear, we find a good description of the disease. He states that it is extremely rare and is essentially the same as herpes zoster elsewhere. In Politzer's text-book there is published a good lithographic drawing of a case in which the anterior surface of the auricle was involved, and a good description of the disease in question. He states "the situation depends on whether the herpes is caused by an affection of the trigeminus (the anterior surface) or the great auricular (posterior surface) or the ganglion belonging to these nerves." I think he refers to the otic ganglion (or Arnold's ganglion). He mentions pain as the prominent subjective symptom, and the characteristic eruption as the objective one.

Most authors mention fever as a symptom, but Politzer states that it is sometimes present. In my case it was absent.

Politzer and others have observed facial paralysis on the affected side. This would seem to indicate involvement of the otic ganglion, which I believe has a branch of the facial entering it. The facial palsy was only temporary.

There is a type of herpes zoster called "Herpes Zoster Gangrenosus Hystericus." Politzer saw such a case. The eruption was located on the tragus and antitragus, accompanied by excruciating pain and characterized by necrosis of tissue in the area affected, followed by deep ulcers and healing by cicatrization, resulting in deformity.

I wish to call attention to the unusual site of the eruption in my case. Neither the front nor the rear aspect of the auricle was involved, but the eruption occurred on the posterior wall of the auditory canal near the drum membrane and in the region of the mastoid tip. There is no case on record like it that I could find. That it was herpes zoster and nothing else, there is not the slightest doubt, for it ran a typical zoster course. Hay (1) of San Francisco, says, "So typical is the eruption of herpes zoster that among the frequently confusing appearances met with in other diseases of the skin, herpes zoster stands as a definite clinical entity."

Etiology.—I could find no authority among the great pioneers and teachers in otology who would any more than generalize on the etiology.

Dench (2) refers to the neurotic diathesis, dietary indiscretions, faulty assimilation, improper and insufficient food as remote causes, and taking cold and local irritation as exciting ones. Brühl and Politzer mention lymph glandular enlargements in front of and behind the ear. The observation of the lymph glandular enlargement preceding the eruption and, therefore, entering in the etiology of zoster in other regions of the body, was first made by Barthelémy (4) in 1891, and has been corroborated by Baudoin (5), Winfield (6), Howard (7), and others. Strümpell (8) has also verified this observation, and Hay (1) (whose excellent article I freely quote and whose citations I make free to use), states that "there seems no reasonable doubt that adenopathy precedes the eruption."

The work of Grindon (9) is notable, and worthy of mention. He endeavors to separate the secondary zoster from the true idiopathic type, and explains the former as being what he calls "zosteroids." By zosteroids he means any herpetic eruption which accompanies and is caused by a local pathologic state. The following are mentioned: (1) Chronic peripheral irritation; (2) traumatism; (3) pressure on nerve trunks (osteophytes, perineural infiltrations, perineuritis, adhesions); (4) infiltration of a nerve or ganglion from some neoplasm adjacent; (5) irritating substances, such as lactic or uric acid in the blood. The eruptions due to these and other like influcurrent types are nearly always the so-called 'zosteroids.'

Eliminating this group and also other known types, such as arsenical neuritis, etc., we still find a large number of cases that cannot be satisfactorily accounted for other than by assuming the presence of some infectious agent. The following arguments in favor of the infectious theory are advanced by Hay: "(a) The attacks occur more frequently in the spring and autumn months (Weis) (19). (b) It is more common in low altitudes. (c) The course is similar to other infectious exanthematous diseases. (d) True zoster rarely recurs; this seems to argue a certain immunizing influence. (e) The recurrent types are nearly always the so-called 'zosteroids.' (f) Family epidemics are reported (Jamieson) (10). (g) Bacteria have been found in a fatal case affecting the face, observed by Graham (11). (h) The constitutional symptoms are out of proportion to the local neuritis present (Unna) (12)." All these argue a general infection.

Neurasthenia has been credited with causing zoster, but in hysteria, mental worry, etc., Cabot (14) states that the blood count is normal, while in zona, leucocytosis is demonstrable. Hay advances this argument to show that hysteria is not the cause. He does this to clear the way for the infectious theory and thinks that the neurotic manifestations are the result, not the cause of zoster. The "hysterical herpes zoster gangrenosus," Van Harlingen (13) states, is not true zoster, but a simple local gangrene. The eruption on one side of the body with the symptoms of general infection, like general lymphadenitis, seems to strengthen the theory of infection as the cause. Those cases of zoster following an injury may be due to the entrance of the specific infection through the infected part, because Rosenbach and Kast (15) have shown that wounds kept aseptic are not followed by zoster eruptions. The curious fact that only a single nerve tract is involved in zoster, seems at first to be incompatible with the infectious theory, but in arsenical and coal-gas poisoning, there is but a single tract involved, and yet there is in each of these a profound systemic poisoning.

A careful microscopic examination of a lymph gland extracted from a zoster case, under the most rigid aseptic precautions by Hay (1), demonstrated the presence of a large number of micro-organisms, evidently pathologic, but not classified, and many unknown thread-like bodies. This finding argues in favor of the infectious theory.

Osler (17) mentions herpes as occurring in trifacial neuralgia, cerebro-spinal meningitis, febricula, malaria, pneumonia, and typhoid fever; but these are not the idiopathic forms of zoster. Writing of true zoster, he states: "The researches of Head and Campbell make it possible that herpes zoster is an acute specific disease of the nervous system, with localization in the ganglion of the posterior roots." I have been impressed in my observation and study of this disease, that the true types of zoster are essentially ganglionic in origin.

We note in the herpes zoster ophthalmicus, that the affection is probably ganglionic, and in this, my case of herpes zoster auris, there was probably an inflammation, due perhaps to infection in the ganglion that exist on the sensory root of the third cervical or some ganglion supplying nerves to the region affected. If the otic ganglion had been implicated, we would have had the pinna involved with eruption, associated perhaps with facial paralysis.

Pathology.—Bärensprung (16) first demonstrated an inflammation of the ganglion in the sensory root of the spinal nerve in zoster, and Osler (17) states that there is an acute hemorrhagic inflammation in this ganglion. "There are hemorrhages and inflammatory foci, with destruction of certain of the ganglion cells." On the other hand, Dubler (18) demonstrated a peripheral neuritis with entire absence of central disease. while other observers have found interstitial neuritis and perineuritis.

CONCLUSIONS.

1 Herpes zoster auris is like true zoster elsewhere, a definite disease usually running an acute course.

2 Herpes zoster auris is very rare, but has been observed by a number of noted authorities.

3 It may involve the membrana tympani, as well as deeper parts of the auditory canal.

4 Herpes zoster is most likely an acute infectious disease, causing neuritis, the storm center being in the ganglion of a sensory nerve.

5 Lymphadenitis is almost invariably present and probably precedes the attack.

6 Treatment is of little avail; the disease usually runs a rapid course and heals spontaneously.

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DISCUSSION.

Dr. E. M. Holmes, Boston, recited a case he had 8 or 9 years ago where he was called at night to see a woman 30 years of age with a perfect past history. She had been suffering pain for two hours in her left ear; it was intense and neurotic, coming on in paroxysms. Examination of the ear showed nothing abnormal, and the canal looked normal. The nose and throat were negative. He thought it fight be a reflex from a tooth, but they were perfect and the only explanation along that line would be the so-called pulp stone which could not be diffentiated. The Eustachian tube was catheterized with the head forward. She was given quite an amount of morphin during the night, but she had the pain the following day. Heat and cold was tried without effect. In 36 hours a bleb occurred at the outside portion of the canal, and that afternoon there were several. The pains subsided after a few days and then again occurred. Three months later she had a general herpes extending over several intercostal nerves. This patient was seen within a year. The doctor was surprised to find a condition so rare beginning in the ear the cause for which he was unable to find. He thought the ganglion theory rather a hard one to prove.

Dr. Wendell C. Phillips, New York, thought that herpes appearing about the ear was perhaps almost as common as the same affection appearing in other parts of the body. It was seen with comparative frequency and he has often observed it in the large clinics over which he presides. So far as his clinical experience went, herpes appearing about the ear was exactly the same as when it appeared in other parts of the body.

Dr. D. T. Vail, in closing, said that since writing the paper he had seen a number of cases of herpetic manifestations about the ear, where deep seated infective processes were at work. He agreed with Dr. Phillips that herpes was frequent in clinics but they all came for some suppurative disease of the ear, and such cases should be classified as "zosteroids" and not true herpes zoster. The case reported by Dr. Holmes he thought was one analogous to his own. His principal object in writing the paper was to call attention to a neglected chapter in otology.

XXXIV.

SARCOMA OF THE NASOPHARYNX—TREATMENT BY INJECTIONS OF ADRENALIN.*

By John Edwin Rhodes, M. D.,

CHICAGO.

The prognosis of sarcoma of the nasopharynx is so uniformly bad that any treatment that offers hope for either the amelioration of the symptoms or a possibility of cure deserves our attention. Having recently had an opportunity of trying a remedy in an inoperable and unfavorable case of sarcoma of the rhinopharynx with encouraging results, I wish to present the method employed to the Fellows of the association with the hope that it may be found worthy of further trial in other cases. The treatment employed was first suggested by Mahu, in 1903, and recently used in a case of carcinoma of the rhinopharynx by Berdier and Falabert with very marked benefit.

Mrs. B. G., 22 years of age, married seven months, was sent to me January 19, 1906, by G. E. Turrill of Cleveland, Ohio. Her mother was living and well, and her father had died of erysipelas, following an injury. There was no history of hereditary disease in the family. She had not been well for about twelve years, and for the last three years had been subject to attacks of bronchitis. She had measles in childhood, and had had several attacks of tonsillitis in the preceding three years. She said that she had had a growth removed from the back of her throat five years ago, and that this had been growing for seven years previously. She had complete relief from all the symptoms connected with this growth by the operation, and had no further trouble until seven months ago, about the time of her marriage. The early symptoms were those of a cold in the head, and she had been under treatment since the condition first appeared. About this time she had an attack of what was diagnosticated pertussis, and the growth in the throat which had been increasing in size slowly before that time, began to grow more rapidly, and continued to enlarge until about two months previous to her visit, since which time it had seemed to remain stationary.

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*Read at the 28th Annual Congress of the American Laryngological Association, Niagara Falls, N. Y., June 2, 1906.

When first seen she complained of a large growth in the back of the throat, completely obstructing the nasal passages, so that no air entered them at all; she also had marked loss of hearing progressively increasing, severe pains, at times, in the back of the neck, radiating to the vertex, a profuse discharge in the nares, which could not be completely removed, because of the obstruction, and also symptoms of dryness of the throat, etc., from the necessity of breathing through the mouth continually. There had been a constant loss of weight, declining from a normal weight of 125 pounds, seven months ago, to 92 at that time. Her appetite was poor, but there had been no fault of digestion and the bowels were regular. The tongue was thickly coated and dry. Her menses had been regular and normal. She said she had become nervous of late. The patient was much emaciated and pale, but her strength was comparatively good, and she was able to come to the office for treatment during the time I had her under observation, although an increasing weakness was evident. She breathed through her mouth, and her voice was the characteristic voice found in complete nasal occlusion. The temperature was 98 F., and the pulse 128, feeble, of small volume, but regular. The heart and lungs were normal.

The nasal cavities were free anteriorly, but the choanae were completely occluded, and the nares were partly filled with thick mucus. The tonsils, uvula, palate, tongue and larynx were normal. A tumor mass presented on the pharyngeal wall, descending to the level of the laryngeal vestibule, and gradually sloping forward and upward behind the velum palati, pressing the latter forward against the posterior molars of the upper jaw. Palpation showed this tumor to be attached on its posterior aspect only, as the finger could be forced between it and the soft palate and choanae, and the Eustachian cushions could be felt by firm pressure. So the tumor had a broad base of attachment on the nasopharyngeal and pharyngeal wall, and undoubtedly originated from the former. It was firm, but not hard, and somewhat lobulated and was pinkish white in color, and on raising the soft palate, its surface was seen to be mottled with bright red spots. It did not bleed easily, and there were no points of ulceration.

A diagnosis or sarcoma was made, and I sent her to the hospital, and the next day removed a mass of the growth for microscopic examination. This showed a spindle celled sarcoma, highly cellular with many lymphoid cells. Considering everything in the case, especially the certainty of a speedy recurrence of the growth, an operation could not be advised, and at the solicitation of the husband that something be done, I made injections of adrenalin into the substance of the tumor, daily. For this purpose I used a needle long enough to reach the tumor through the nasal cavities. I had the following solution prepared by my druggist:

Adrenalin chlorid	Gm.	0.12
Acid boric		0.60
Chloretone		0.025
Aqua destillata		15.

Misc.

Ten minims equal five milligrams of adrenalin chlorid.

An injection of five minims of this solution was made into the faucial portion of the growth on January 25th, and a 1-1000 solution of the same was swabbed over the surface. About twenty minutes after the injection she had some nausea, but there was no faintness or any appreciable effect on the pulse. An ulcerated spot had appeared on the anterior surface of the soft palate, due to its being crowded against the left posterior molar by the pressure forward of the tumor, so the injection was made into the portion of the tumor directly behind the ulcerated spot.

On the 27th I injected ten minims of the solution into another place. On the following day I injected the tumor through the right naris, and the next day through the left. In this way I alternated the site of puncture. After the second treatment diminution in the size of the growth was apparent. On the 30th the retraction was shown by the removal of the pressure from the site of the ulcer and the healing of the same. There was an almost complete restoration of hearing from the removal of pressure from the Eustachian tubes, and the pain was very much less.

I made seven injections, when it was thought advisable to send her home and to have the treatment continued there. At her last two visits the injections caused an almost immediate nausea and vomiting. She had become much weaker at this time, and in her extremely nervous condition on the last day, there followed some faintness with blueness of the lips and weak pulse.

The encouraging results of this treatment were the immediate reduction in size of the sarcomatous mass, and the temporary alleviation of pain. Dr. Turrill continued the treatment after her return home, and wrote me that he had alternated the injection in the nasal cavities and throat with .00025 mg. adrenalin daily, using .005 mg. but once, making seven injections only. The improvement was noticeable, and in about ten days she could blow the left nostril and breathe through the naris at times. Then she had become very weak, with considerable gastric disturbance and vomiting, due she believed to a remedy she was still taking. This was now discontinued. The fauces became inflamed and swollen, but there was no visible increase in the size of the tumor and no necrosis of tissue. A spray of adrenalin relieved the throat symptoms. An attack of diarrhea still further weakened her, but this soon subsided. The treatment was discontinued. The fearful exhaustion due to the inroads of the disease persisted, notwithstanding every effort at nourishment and stimulation, and the patient died March 15th.

While the results were only encouraging in this case, in view of the experience of Mahu by topical application and the notable improvement of the cases treated by Berdier and Falabert, I assume that the method should be given a trial in other instances.

Mahu (*La Presse Medicale,* April 4, 1903) treated three patients with ulcerating epitheliomata by local applications of adrenalin (1-1000) and found it arrested persistent hemorrhage, suppressed the pain, and there followed a rapid and continued amelióration of the general condition of health. He did not claim curative effects, but in each case the neoplasm seemed to have been arrested in growth, for a time at least, and there was less tendency to spread and to invade new tissues. The disease in these cases respectively involved the tongue, the larynx and the laryngeal vestibule. He suggests in conclusion that attempts be made to destroy certain circumscribed epitheliomata by adrenalin injections.

Berdier and Falabert (*La Escuela de Medicina,* Tomo XX.

Num. 24, Dec. 31, 1905) report a series of nine cases of cancer, treated by subcutaneous injections of adrenalin in the internal ones, and interstitial injections in the external ones. The cases are reported at length. The first was one of cancer of the rhinopharynx. The man was fifty-two years of age. He had no specific history and family history was negative. He was well until July, 1902, when he had an attack of erysipelas. In February, 1903, he began to have severe pain in swallowing and intense headache. The nasal passages became occluded. This continued about a month, when an eruption appeared about the nostrils, and there was a foul, sanious discharge from the nose. In June he consulted several specialists, who pronounced his case cancer of the rhinopharynx, and gave a grave prognosis. Later, some portions of the growth were removed. He was finally sent to Dr. Berdier for more radical treatment, in June, 1904. At this time the isthmus of the fauces was very much deformed, the palate very tense, hard, infiltrated, lustrous; the anterior pillar on the right side in a similar condition, extending forward into the buccal cavity, where there was a vegetating mass, irregular in form, covered with a false membrane, gray, adherent, and of a very fetid odor. Posterior rhinoscopy was impossible, but on palpation there was found a hard, irregular mass in the nasopharynx, bleeding easily. The anterior nares were free, save a slight thickening of the mucous membrane. Dysphagia was marked and there was difficulty of respiration. The mucous membranes were pallid. The submaxillary glands were enlarged and hard, and there was enlargement of the axillary and inguinal glands, also. He had had thorough anti-specific treatment over an extended period, without benefit. Topical applications of lactic acid, potassium chlorate, and various other remedies were also tried, but internal remedies were suspended on account of their irritation of the stomach. An application containing cocain 1 to 30 was applied and a gargle of chloral 1 to 200 was used and also enemas of peptones. On June 29th there was some improvement, less odor, he could breathe a little through the nose, pain was less and at greater intervals. The thermo-cautery was used at this time on the oral growths. This improvement was of short duration, and the patient soon became worse. July 10th he applied adrenalin 1-1000 topically to blanch the exuberant masses and reduce the growth. This gave some relief till August 24th when the condition of the patient was so bad that respiration was labored and stertorous, articulation difficult, as was deglutition also, even of liquids, from increase of the growth and glandular enlargement. Tracheotomy was advised but deferred on recommendation of Falabert, called in consultation, and interstitial injections of one-half milligram of adrenalin begun at irregular intervals of a day or two. In a few days the glands of the neck began to diminish, the patient could open the mouth and began to articulate better, some of the enlarged glands having disappeared after the eighth injection. On September 12th the conditions had changed remarkably. The soft palate had regained its elasticity and motility, the isthmus of the fauces presented an almost normal appearance, the thickness of the mucous membrane had diminished, there was less disturbance in mastication, and the patient could speak more plainly. The axillary and other glands had diminished very noticeably in size. On September 28th a marked gain in weight was noted. In April the weight was 68 kilograms, and this had declined to 46 in September and increased to 56 under the treatment. The patient was reported in good health at the time of the presentation of the paper. It is unfortunate that a histologic examination was not made in this case, but it was seen by a number of the best specialists and they agreed as to the diagnosis. The other cases were cancer of the esophagus; three of cancer of the stomach, one of which was confirmed by a post-mortem; one of epithelioma of the uterine neck; one of epithelioma of the skin, and two of the tongue and mouth. In each of these cases improvement in a marked degree is noted, evidenced by lessening in volume of glands involved, decrease in size of tumors, marked amelioration of pain, increase in weight and general improvement in health.

They conclude that when adrenalin is locally applied or injected it has a great influence on cancerous growths and they advise its use in all cases of cancer, and think it should largely replace morphin as an analgesic.

No satisfactory explanation can yet be given of the physiologic action of the adrenalin in cases of such pathologic change as occurs in cancer and the subject has never been thoroughly studied. Elliott (*Journal of Physiology*, V. 32) has made many and valuable observations of the effects of adrenalin on animals. In his exhaustive treatise, he shows that it accelerates and augments the heart beat, as do the cardiac accelerator nerves, and that it constricts the blood vessels of the body as do the sympathetic nerves is proven. Constriction is produced in the largest arteries as well as in the arterioles. Another author states that he had found that in the area around the point of the injections the blood vessels were constricted. Vascular dilatation is probably not produced by it, and the veins seem not to be influenced.

On local application to unsound flesh, it blanches it quickly and briefly, being succeeded by venous hyperemia. Its application to plain muscle invariably is followed by contraction, no retraction and relaxation. Melzer and Auer (Trans. Assn. Am. Phys., 1904), in their studies of the effects of injections of adrenalin in delaying the toxic effects of strychnin, concluded that in some way there was an impairment of absorption through the blood vessels by the tissues. They also found that the blood of adrenalin animals clotted more easily. They brought out also another interesting fact, that the suprarenal extract possessed the property of increasing tonicity of contractile tissues, which lasted the longer the less organized this tissue is, showing that the effect is not of short duration. In brief their theory is "It causes an increase in tonicity of the contractile protoplasm of the endothelia of the blood capillaries and lymphatics. This increase in tonicity narrows the lumen of the pores and decreases the facility for the interchange between the blood and the tissue fluid."

It is certain to my mind that in some way the action of the adrenalin is expended largely on the vessels and the blood stream and thus cuts off the nutrition in these growths. At the same time it must have some specific action upon cancerous growths, if we accept the conclusions arrived at by the results in the cases reported by Berdier and Falabert, above referred to. Certain it is, that under an interstitial injection there was an increasing shrinkage of the sarcoma I have reported, and there is no reason to think that this shrinkaye would not have continued if the injections could have been employed longer. The evident increase in physical strength and well being in other cases treated by this method would also tend to show that my patient's rapid decline had nothing to do with the treatment, but continued in spite of it, as is usual in such cases without treatment of any kind.

As this method is new and the action of adrenalin when injected over a long period and frequently is not yet thoroughly understood, I believe it will be necessary to be cautious in its administration.

Joseph L. Miller has, within the past month, presented at the Congress of American Physicians, at Washington, and admirable study of the production of arterio-sclerosis by the continued administration of adrenalin. In a personal note he has given me briefly his conclusions as follows:

Josue, in 1903, first demonstrated that repeated intravenous injections of adrenalin chlorid would produce in rabbits marked degeneration and calcification of the media of the aorta. It is quite remarkable how rapidly these vascular changes may occur even in as short a time as five or six days or after three to four injections. A few observers have succeeded in producing these same changes by the subcutaneous use of adrenalin and by injecting it into the trachea. The question then arises whether this is a safe remedy when used subcutaneously in man. We know that when given in this way it causes a considerable rise in blood pressure, and this has been considered as an important factor in the arterial changes. Since it has been shown that digalen when administered intravenously to rabbits, may cause arterial changes of similar character, it is probably safe to say that adrenalin is not more dangerous than some other drugs in common use. Of considerable interest is the recent work of Korany, who found that after injecting the animal with iodopin the adrenalin did not produce any change in the vessel.

Elliott found that the daily repetition of small amounts in animals experimented on causes atheroma of the aorta and coronary arteries. The remedy, however, is non-cumulative in action. Would we encounter a like condition in man and should precaution be necessary? The dosage would have everything to do with such a possibility. The experiments by different observers undoubtedly show that calcification of the media of the aorta, and degenerative changes in blood vessels can be produced by injections of adrenalin. It must not be forgotten, however, that the dosage necessary to produce these changes in the animal must be very large, increasing from about three minims to each kilogram of weight in the rabbit. Rabbits of 2000 gm. have been killed in 2½ hours by 20 mg. of pure adrenalin. Smaller doses do not produce atheromatous changes. In human beings it would be necessary to use a proportionate dose—as 180 minims of 1-1000 solution for one weighing 60 kilograms,—very many times larger than it would be considered safe to use or that would be recommended. There is no doubt, therefore, that the production of an arteriosclerosis in man would be a danger that practically does not exist. A careful histologic examination of the tissues being treated should be made, as it has not yet been demonstrated what the changes in pathologic structures at the site of injection have been.

I unfortunately did not have my patient under observation long enough to permit such examination, but in other cases I trust it will be made. The unpleasant effects of the amount I used may have been due to the rapidity of the injection and possibly the size of the dose. Melzer found the toxic effects of injections of bile much influenced by the rapidity with which they were made and that the rapid injection of a small quantity may have a fatal effect, while a much larger dose could be given slowly without such result. I think this precaution would be well in the use of adrenalin. Death comes speedily in animals from the injections of large quantities of adrenalin, and smaller quantities have provoked glycosuria and inflammatory changes in the liver and kidneys. Symptoms of weakness, prostration, nausea and vomiting may have been evidence that too large a dose was used. I believe 2½ mg. is a safe dose for an injection and possibly 5 mg. is not too large in some cases. The nausea and vomiting, while not severe or prolonged in my case, seemed to be an indication for a smaller dose. I would, therefore, recommend only one milligram every two or three days, as initial dosage for an adult in most cases with a possible cautious increase.

In conclusion, it seems to me, that this method merits trial, especially in carcinomata and sarcomata of the throat and nose, where an unfavorable prognosis must almost without exception be made, and the earlier it can be resorted to the better. I believe it may be safely asserted that it may replace morphin as an analgesic in these cases and that it has a palliative effect, while we have no proof of its being curative in its action as yet. In operable cases, however, where delay would be dangerous, a resort to surgery, as heretofore, should be the rule, until the matter has had further trial.

XXXV.

INFECTIVE SIGMOID SINUS THROMBOSIS—RESECTION OF INTERNAL JUGULAR—REPORT OF CASE—RECOVERY.

By H. Bert. Ellis, M. D.,

LOS ANGELES.

The free communication between the pneumatic spaces covering the lateral sinus and the sinus itself, by the mastoid veins, renders an involvement of the lateral sinus very likely whenever a suppurative process exists in the mastoid; but, as a matter of fact, another very common source of infection is suppuration of the middle ear, the infection reaching the sigmoid sinus by way of the superior petrosal sinus or small venous tributaries, without necessarily a septic process existing in the mastoid.

In brief, infective sigmoid sinus thromboses are ordinarily of otitic origin, and may or may not be secondary to mastoid involvement, however it is through the mastoid we must attack these conditions; not infrequently septic foci are found in the mastoid, though apparently not connected as cause and effect, at the same time as the septic thrombosis.

Infective sigmoid thrombosis occurs more commonly in adults, in males, on the right side and is decidedly more frequent than brain abscess. When an infecting deposit invades the inner lining of a sinus, a fibrous clot forms which may finally occlude the lumen, and pyogenic bacteria develop in the clot, which leads to a general septic infection. The clot may remain localized or extend on down into the internal jugular vein and on to the heart, or pieces of the clot may break off and be carried to other portions of the body and become foci of infection.

The symptoms of this infection are insidious and may not be discovered for some time after the initial involvement.

1. The characteristic symptom, which is most likely first to be noted and possibly the only one, is a sudden rise of the temperature followed by spontaneous and as sudden a drop

of the same to the normal or nearly normal condition; therefore, the temperature should be taken frequently in acute suppuration of the middle ear whether or not there be mastoid involvement. If there be a meningitis or brain abscess besides the sinus thrombosis, this symptom is somewhat disguised, as the temperature seldom drops lower than 101° to 100°. An uncomplicated sinus thrombosis temperature wave frequently amounts to 6° to 8°, and is probably due to the periodic passage into the circulation of broken down portions of the septic clot within the sinus, causing a general infection. If this condition continues for some time a general sepsis develops, with emaciation and an ashy-hued skin.

2. A severe chill is a frequent symptom, but is often entirely absent. Its existence makes the diagnosis the more easy, but its absence in no way excludes sinus thrombosis.

3. Profuse sweating nearly always follows the sudden rise of temperature, but even this may be absent.

4. Headache, mental dullness, paralysis or convulsion when occurring with the other symptoms of sinus thrombosis leads one to suspect and look for a meningitis or brain abscess.

5. A sinus thrombosis which has existed for some time is likely to extend downward into the internal jugular vein. When this does occur there is likely to be some tenderness along the sterno-cleido-mastoid muscle, but personally I have never felt the cord-like ridge which many authors speak of as occurring in this condition.

6. Swelling of the lymphatics behind the ramus of the jaw sometimes takes place in sinus thrombosis, but is of but little diagnostic value, as it may arise from middle or external ear trouble without any involvement of the sinus.

7. The fundus of the eye should always be examined, and if choked disc of opposite eye be found, the sinus, brain or meninges will be likely involved.

8. An unusual and unaccountable depression and weakness is very likely to be found in patients suffering from thrombosis, and its presence may be considered contributory evidence.

It is not necessary here to describe the mastoid operation, but having opened up the mastoid antrum and cells and having removed all infective foci in that region, exposure of the sinus is undertaken. This is sometimes very easy, especially when there has been much involvement of the mastoid and the sinus groove has been eroded; at other times the difficulty is great, but at all times the greatest care must be exercised in removing the bone, to the end that the sinus be not accidentally opened before you are ready; or that the contained clot be not broken by manipulation. Probably the most satisfactory instrument for this part of the operation is the chisel, as with it you are less likely to wound the sinus wall or disturb the clot. The sinus should be exposed as low down as possible towards the bulb and as high up towards the torcular as may be necessary to expose healthy sinus. If, after having exposed the sinus and having demonstrated that it contains no thrombosis, though the symptoms indicate that it does exist, then it is well to expose the jugular bulb and superior petrosal sinus, for in either of these may lie the trouble.

The appearance, the feel and the pulsation of the sinus have ceased to be large factors in determining the contents of a sinus, because they have so frequently been found to be deceptive. Whenever symptoms of septic sinus thrombosis occur, even though the sinus looks and feels all right, it is our duty to open it. The sinus should be thoroughly opened and when healthy walls are found at both torcular and bulb ends of the opening, pressure plugs may be used and the unhealthy tissue resected, but if thrombosis extends down into the bulb or if the lower portion of thrombosis is undergoing degeneration, then it is decidedly the safer move, for the patient's life, to ligate and resect the internal jugular vein before attempting to remove the thrombus; and when curetting the bulb after a ligation of the jugular it is well to make deep pressure on the opposite internal jugular so as to cut out as far as possible the carrying of small clots or debris into the general circulation by aspiration.

Having curetted the bulb and cleansed the sinus as thoroughly as possible, it is well to carry a piece of gauze into the bulb as far as the postcondylar vein, in order to develop a sudden coagulation and an aseptic thrombus in the bulb, and establish a cross current between the inferior petrosal sinus and the postcondylar vein.

Rapidity of action and gentleness of manipulation are almost as essential for a successful outcome in these cases, as is the operative interference. The mastoid operation, the sinus operation and the resection of the jugular should be done, if possible, as one operation, at one sitting, and with the utmost despatch, as the danger from shock in this trouble is exceedingly great, and the divided operation is not particularly prone to decrease the mortality rate of this disease.

Report of an operation illustrating this complication: On May 6, 1905, I was called by a confrere in a suburb of Los Angeles to examine with him one of his patients, Miss N.N., a physician's daughter, aged 32. From the patient herself, her sister and the doctor I obtained the following history: When 2 years old she had an attack of acute otitis media with profuse suppuration on the right side. The discharge continued for some time before ceasing, and had recurred several times, during her early life, but she had not had an attack or, in fact, any discharge whatever since coming to California, which had been some five years. On Saturday, April 29, on returning from her work she complained of pain in her right ear and a general headache, which increased in severity as the days passed along. On Sunday the ear began discharging, but the pain in and about the ear continued and was quite severe. She had had some elevation of temperature, but no record had been kept. A nurse was called on May 5th and her records show that between noon of the 5th and noon of the 6th, when I was called in consultation, the patient's temperature varied from 99.2 to 105.2; pulse, 93 to 126; respirations, 18 to 34. Free perspiration after high temperature, dizziness, vomiting, small amount of discharge from the ear. Considerable pain in mastoid region, but only slight tenderness on deep pressure over the antrum. No sagging of postero-superior wall of the canal; the perforation in the drum head was just behind the handle, about the size of a pin head. There was no tenderness along the course of the internal jugular nor was there any lymphatic enlargement. Diagnosis of infective sigmoid sinus thrombosis was made and operation advised as soon as instruments could be obtained and house prepared.

It was thought the danger was too great to have her brought to Los Angeles to a hospital, a distance of some twelve miles. So we utilized the dining room, which the nurse made as aseptic as possible. We operate at 5:30 that afternoon. The mastoid was petrous throughout. The antrum was large and filled with pus and cholesteatomatous mass. Deep in the substance of the mastoid and extending from the antrum to the sinus groove at the knee, was a strip of softer bone, which was probably the line of infection. The sinus was carefully uncovered (the overlying groove being softened for about 1-3 inch at the knee along the vertical limb), from above this softened tissue to near the jugular bulb. The sinus wall was dark, lusterless and unhealthy in appearance. Palpation gave no definite knowledge. The hypodermic syringe brought away a few drops of stinking, bloody pus; this decided me to ligate the internal jugular vein before disturbing the thrombus. On exposing this vessel, I found a firm clot down the entrance of facial vein, and below that point the vein was only partially filled with blood. I ligated the jugular about one inch above the clavicle, and the facial just above its juncture with the jugular and resected up to clot, and the lower end of the neck wound was temporarily packed. Returning to the sigmoid sinus, I slit it open the full extent of its uncovering and evacuated a very offensive, pussy blood, curetted the sinus as far toward the bulb as possible, and succeeded in getting a fair return flow and introduced gauze to the bulb. The clot in the descending limb of the sinus was then gently removed with the curette and a generous gush of blood washed out all infective material, the hemorrhage was at once checked with gauze plug. As the neck wound had ceased bleeding, and the clot in the jugular vein was firm, the wound was closed and the mastoid wound dressed as usual.

During the next twenty-four hours the temperature never went above 99.2, pulse 97, respiration 24, but about six o'clock p. m. the patient had a slight chill and vomited; temperature went to 102.6. At ten o'clock she had chill lasting fifteen minutes; temperature 103, pulse 131, respiration 31, but after a free movement of the bowels the temperature dropped to 99.6 and the patient had restful sleep. At 6 a. m. on the 8th, the second day after the operation, the mastoid wound was dressed because of the more than ordinary oozing. At noon on the 9th the temperature suddenly went up to 100.6 from normal, and as the patient was complaining of some discomfort in the neck a general dressing was done, the upper portion of the neck wound was inflamed so one stitch was taken out and small amount of pus removed; this probably came from degeneration of the unremoved thrombus.

Thereafter the upper portion of the neck incision was treated as an open wound, and the patient went on in an uneventful way to recovery, and at no time did the temperature exceed 100, the pulse 80 to 90 and respiration 18 to 20.

On the 29th the patient took a long drive, and from that time on went to office for dressings.

After resection of internal jugular for sinus thrombosis, it would seem to me better policy to treat the neck incision as an open wound, no matter how clean the parts may be.

DISCUSSION.

Dr. E. B. Dench, New York, thought it a very interesting case, one which clearly showed what good results could be obtained by prompt intervention. He saw a similar case in which there was only a sudden rise in temperature. The entire drum membrane had been destroyed, and if there ever was a case where good drainage could be obtained that was it; yet on opening up he found a thrombus extending to the jugular. Iodoform packing was introduced to prevent infection from the broken down thrombus. The patient, a woman, was placed upon the table with a temperature of 106, yet the wound healed by primary union. He agrees with Dr. Ellis as to the treatment of neck wounds as open wounds in every instance. Half of the cases he has had have healed by primary union; and if the temperature does rise, he advises removal of the sutures and treating it then as an open wound. In this way more rapid healing can be secured, than if the tissues are allowed to be widely separated. In a fairly clean case it is wise, in the speaker's opinion, to suture. Another point he mentioned was the application of a wet dressing, which gives one a firm union of the cut structures, and the deeper part of the cavity rapidly heals. If it is not aseptic, it would drain from the lower angle.

Dr. E. M. Holmes, Boston, reported the case of a boy who had been operated upon by Dr. Leland a week ago. He had been admitted to the hospital on account of two days' headache. He had a running ear for eleven years. The temperature was normal, but the ear was discharging a small amount of pus. There was no tenderness or enlarged glands to be found anywhere. The only marked thing was a subnormal pulse running about 42 to 50. When the mastoid was opened, the cells were found to be filled with granulation tissue, and the lateral sinus wall was of a darkish blue color filled with pus. Before opening the sinus the jugular was tied and the upper portion dissected out, but there was still a dark appearance of the inner wall of the sinus. Incision at this point was followed by about a dram of pus. Immediately there was cyanosis and artificial breathing had to be resorted to. The patient recovered and is now on the road to recovery.

Dr. E. W. Day, Pittsburg, was very much interested on account of the temperature. Last November he had a case come into the hospital, a boy, who had chronic discharge for years, with intense headaches. He came from school and that night his temperature was 102; he had a chill and went into semi-coma. On his arrival at the hospital, his temperature was 94.6. At no time did his temperature rise above 95.4; the pulse was between 56 and 60. On opening the mastoid, the cerebellum and the sinus were exposed. The sinus was absolutely gone, and at the point of the sigmoid sinus location, no trace of it could be found, but there was much pus and debris. The lateral sinus was thrombosed. The collapsed vein was found and the surface of the dura over the cerebellum, the walls of the lateral sinus and the superior surface of the cerebellum were found necrosed. The patient never recovered consciousness and died with a temperature and pulse entirely subnormal.

Dr. H. L. Myers, Norfolk, stated that his experience in cases of resection of the jugular in sigmoid sinus cases had not been large; in fact, he had done the operation only three times. One of these cases had come into the hospital presenting a marked swelling over the right mastoid region and the ear was discharging freely. Twenty-four hours after admission the mastoid was opened and found in very bad condition; despite this fact, the temperature was normal at the time of the operation as it had been previously when we could examine it.

The ordinary mastoid operation was performed. On the third day the temperature rose, and from the septic look of the child and other signs such as great depression, he determined to explore the sinus. The operation disclosed a badly thrombosed sinus, and after establishing the flow from above and failing to establish it from below, the jugular was resected from as high a point as possible to near the clavicle, a cigarette drain was introduced and the neck closed. Three days later the temperature took a jump to 103° F., and on opening the dressing I found the neck wound full of pus and the drain doing little service. the sutures were removed, the wound cleansed and treated openly and the patient had a rapid recovery. In every one of the three cases coming under my observation, the neck wound was closed and had to be treated as an open wound afterwards on account of infection, despite the best surgical technic I was capable of. After this experience, I confess I began to feel that it is of little use to close the neck wound at the time of the resection.

Dr. B. E. Fryer, Kansas City, asked if in these cases of subnormal temperature any blood count had been made. He would suggest that a leucocytosis in these cases would be diagnostic. Where there is subnormal temperature, with sepsis involving the jugular, as a rule oscillating temperature prevails, but where it remains down a hypoleucocytosis is an indication of the want of reactive power.

Dr. E. M. Fleming, Los Angeles, reported a case of 100 days' duration. The man came with an acute otitis media, and was relieved after incision of the drumhead. At the end of four weeks, the discharge still profusely present, it was suggested that he would probably not recover unless mastoid operation was performed. There were no symptoms of mastoiditis, and it was suggested simply on account of the persistent and profuse discharge. Operation was refused on the ground that he was a diabetic. During the next thirty days he received office treatment and there was no high temperature. One month after having advised operation he was suddenly seized with two slight convulsions and apparently recovered with ill effects, but still refused operation. Thirty days later he had another seizure, with complete aphasia and a semi-unconsciousness; the operation was again strongly suggested. He was taken to the table and fluid pus was evacuated and the presence of a temporo-sphenoidal brain abscess made out and in Broca's area a large quantity of fluid was found. After the operation the patient died. This condition may exist without typical symptoms.

Dr. E. B Dench, New York, desired to place on record a case of pronounced general chorea in which operation was delayed, although there was suppuration. Choreic convulsions were so violent that the anesthetic was with much difficulty administered. The dura was exposed over the middle cranial fossa, but it was found to be normal. The chorea disappeared after the operation and has not since returned.

Dr. C. W. Richardson, Washington, said that the diagnosis of thrombosis was not always easy, and at times there was considerable doubt. During the past winter he had two cases which would illustrate this difficulty markedly One was a child 9 years of age who was unconscious and in the throes of violent convulsions, with a temperature of 105. The urine had been examined and sugar and casts were found. The physician in attendance called in the speaker simply because the child had had chronic suppuration from the ear. It was at once taken to the hospital and operated upon. An extradural abscess was found with no involvement of the sinus. The most remarkable thing about the case was that the urine ran between 90 and 132 ounces per diem for nearly a week. Another case was the child of a neighboring physician about 2 years of age that had been running a temperature three or four days, for which there was no apparent cause. The speaker was called early on the fourth day because the child continually had its hand on the right side of its head. The child was watched for five days, during which time it ran a temperature from 99 to 104 or 105 every day. There was free drainage and no bulging and no tenderness over the mastoid. Blood counts made on the third and fifth days showed no leucocytosis. On the seventh day the mastoid was explored and a typical osteomyelitis was found. The sinus was free, firm and normal. These two cases both suggested involvement of the sinus, yet in neither case was it affected.

Dr. Joseph Beck, Chicago, related two interesting points in a typical case of sinus thrombosis, where it had extended almost two-thirds down the neck and jugular, and where an exposure for the usual radical proceedure for mastoid was done. On the following morning the temperature was 99; it had been 104 before the operation. Three days later the patient had a chill followed by pain in the right side of the chest, high temperature and a rusty sputum lasting three days. Three days later the condition was repeated on the opposite side, also clearing up after three days. Pneumococci was present in the sputum. He had repeated chills during five weeks with fever and the usual course of a septicemia. Good results were obtained by the hypodermic injection of glycogen in these cases.

Dr. E. W. Day, Pittsburg, showed a few temperature charts from cases of mistaken diagnosis. The first chart was a case of a boy 5 years old who had had measles with a middle ear suppuration. The measles cleared up, but the ear continued to discharge, and he complained of pain in the mastoid. The temperature ran from 90 to 104 and 106 with chill and a good fall to 99, then up to 105 and then below 100 and up and down. The doctor expressed some doubt that it might be sinus thrombosis. An expert was sent for and the child examined and he diagnosticated pneumonia. Nothing was done to the mastoid, the pneumonia cleared up and the patient recovered.

The next chart was in a case of measles; the child had apparently been healthy for two months prior to the time spoken of. Each afternoon the little girl would say she felt tired and wished to be held. Suddenly, one Sunday night she complained of pain in the ear with profuse purulent discharge. She immediately began to run a temperature of 102, falling to 99 and rising in the afternoon to 103 and zigzagging, until, ten days later, when the glands along the neck became swollen and tender over the mastoid. The case was examined by four other physicians and no complication could be detected. As it was the doctor's own child he could not bring himself to the point of having it operated upon. Five days later the opposite glands and the inguinal glands became swollen. The blood count showed 23,000 leucocytes, the polymorpho-nuclear cells were 63% and the hemaglobin 50%. Dr. Litchfield thought it a case of malnutrition and that the ear was simply a manifestation of that condition. Operation was not performed and the child recovered.

The next chart is of a little patient seen the latter part of March. He had measles with ear trouble. A month later the mastoid was bulging and the patient was operated upon, but instead of getting better it grew worse. The other mastoid was opened, but still it remained in a bad condition. Pus was found in both mastoids. The chest was thoroughly gone over. The blood count showed 63% polymorpho-nuclear cells and the leucocytosis was 27000. Sinus thrombosis was then suspected, both sinuses were opened and both were absolutely normal; the temperature then began to zigzag. Typhoid tests were made, but they proved negative. At the post-mortem the veins of the brain were found to be slightly congested. When the sinus was opened a probe was passed and a free return of blood was obtained; but in the right sinus a non-adherent clot was found, having its origin and fastened to the point that was cut. In the lungs, lying between the pleura and pericardium, a pus sac was found the size of a hen's egg. The right lung at the upper portion showed an old pneumonia, and below it a recent pneumonia and in the left lung a still more recent pneumonia. The doctor thought that in many of these cases in children, the fact was overlooked that a great many other conditions gave rise to the symptoms simulating thrombosis of the sinus. He believed that very often in children and babies a condition is present that was referable to the respiratory tract and which cannot be diagnosed, and too much pressure is brought to bear on the sinus thrombosis theory and the other conditions overlooked.

Dr. J. A. Stucky, Lexington, said that Dr. Day had brought out the point he had tried to emphasize at Buffalo last June: that the symptoms caused by intestinal toxemia simulated those of sinus thrombosis as far as temperature showed. He has never opened the lateral sinus. The septic condition of the mastoid present, plus the condition produced by the anesthetic, so weakened the intestinal canal that the toxines are absorbed and the symptoms of sinus thrombosis are made manifest. Two or three doses of castor oil and a colon tube, he thought, performed wonders.

Dr. Wendell C. Phillips, New York, wished to protest at the unwarranted operative interference in suspected cases where the diagnosis was based upon high temperature only. Young children previous to rupture of drum or paracentesis were extremely prone to high temperature, which usually subsided promptly a few hours after a free opening in the drum had been made. These cases also usually had a high polymorpho-nuclear percentage.

Dr. E. M. Holmes, Boston, said regarding the blood count, one case showed 11000 white and the next day there would be but 9000 and on the third day after operation 14000. It was not always absolute.

Dr. J. F. Barnhill, Indianapolis, thought there was a possibility that Dr. Day's case had a lateral sinus thrombosis which was taken care of by the child's own system.

Dr. E. B. Dench, New York, said there were some cases that did well without operation. He had found in one case the lateral sinus absolutely obliterated, yet the patient recovered. He had a case, a child, 18 months old, for whom he was consulted, who had an unexplained temperature. He performed double paracentesis, and after seven days the temperature rose to 107°. Two careful diagnosticians went over the chest, but said they found nothing. The leucocyte count was 27000 and the polymorpho-nuclear 87%. The next day the temperature went down to 99 and the child gradually recovered. Another child of 18 months had run an irregular high temperature for five days. For the first three days there were no ear symptoms. Incision; staphylococcus infection present; no drainage. Three myringotomies were performed. There was no tenderness over the mastoid, but there was swelling of the canal. Everything else was excluded. The blood count had been made and a high leucocytosis was evidenced, so pneumonia was sought after. The day following the polymorpho-nuclear were down to 29%. The mastoid was opened and was found to be filled with pus, yet the bony wall was firm. Forty-eight hours later the sinus was opened and a clot found extending from the knee seven-eighths of an inch to the torcular Herophili. The wound was packed and the temperature began to fall. Sixty hours after the operation, at the first dressing, there was a slight amount of pus, of which the speaker was afraid. That night the temperature again rose to 107, but the following morning at 7 it was down to 99, and the jugular vein was incised from the innominate to the base of the skull. It was like a pipe stem. The child died ten days later of sepsis.

XXXVI.

THREE FATAL CASES OF MENINGITIS WITH PECULIAR EAR SYMPTOMS.*

By Dr. W. H. Roberts,

PASADENA, CAL.

These cases with their post-mortem findings are reported in the hopes that what is learned may be of benefit to us all, and particularly that from the last two we may learn to look earlier for symptoms of meningeal involvement.

The first is chiefly of interest because the autopsy so clearly confirmed the diagnosis made over a month before death, and because of the remarkable condition found in the middle ear.

The last two, I think, teach among other things, that we should never examine an ear with an acute otitis media without keeping ever before us the possibility of a meningitis developing in spite of the proper treatment being instituted. We should therefore always be guarded in our prognosis in all acute middle ear inflammations.

Case 1.—On January 20, 1905, W. H., age 50, came under my care bearing the following letter from his physician in the country:

"Dear Doctor:—The bearer came to me about two months ago with neuralgic pains in and about the left ear and brow, and in a general run-down condition, which I attributed chiefly to a very septic condition of the mouth. He has had the pains off and on since that time, has continued weak and hardly gains at all. About a week or ten days ago, swelling, slight redness and tenderness on pressure over the mastoid tip came on. There has, at no time, been any discharge from the ear. Evening temperature has been slightly raised for some time and pulse about 100. Deafness was about complete when he came to me, although he says he had quite recently received telephone messages with that ear. Watch tick audible about eight inches on the other side, but today it is almost deaf to watch tick. I blistered over mastoid twice when he first came to me."

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*Read before the Western Section of the American Laryngological, Rhinological and Otological Society, January 27, 1906.

On examination I found the entire mastoid tender, considerable edema of the tip and neck, drum dull, thickened, but not in the least congested. No evidence of perforation, no sagging of the canal, very marked degree of deafness. Temperature 99.8.

Diagnosis: Mastoiditis with Bezold perforation of the tip.

I advised patient to go immediately to the hospital and expected to operate that evening. The patient consented, but expressed a wish to return home for an hour or two in order to attend to some necessary business before going to the hospital. Nothing more was seen of him until the morning of the 24th of February, when a telephone message was received from his home in the country, saying that he was in a very bad condition—dying, it was feared.

On my arrival there I learned that the man had been losing ground steadily for some weeks, although complaining less and less of pain around his ear until within the last two or three days, when he remained in bed most of the time with hot applications to the ear. The morning before, he complained of very severe pain in the small of his back, which he had injured some years before by being thrown out of a buggy. Toward evening he became rather irrational, with a slow pulse in the neighborhood of 60.

All night he was exceedingly restless and on the morning of the 24th he could only be aroused with difficulty. I found skin cold and clammy, patient groaning, throwing himself from side to side in the bed, and at times holding his hand to his forehead and left ear. Pressure over the mastoid made him wince, and on asking if it hurt he replied "Yes," the only intelligent answer obtained. There were no facilities in the house for making a satisfactory examination, but because of the slow pulse I thought there was the possibility of brain abscess, and as the sons wished to take the chances of an operation, I had the patient taken to the hospital in an ambulance, where I saw him at five o'clock, with Dr. Hill Hastings, of Los Angeles. Temperature 102 deg., pulse 100. The entire condition had changed, patient then showing signs of active meningitis. Lumbar puncture obtained turbid serum which contained the pneumococcus. I refused to operate and put an ice pack to his head. Patient died at five o'clock the morning of the 25th.

Autopsy was performed that evening by Dr. Stanley P. Black and myself. Found a diffuse purulent leptomeningitis, most intense at the base of the brain. No signs of abscess. The dura was exceedingly adherent over the left temporal bone, particularly over the petrous portion, and a perforation existed over the roof of the mastoid antrum. The bone was very congested over the antrum and middle ear and much softened. On opening the antrum I found it filled with pus, as were all the mastoid cells, which had practically broken down, forming one large cavity. The probe passed readily through the perforation at the tip of the mastoid and three inches into the neck. After removing the softened superior wall of the attic the middle ear was found entirely normal and dry, mucous membrane not adherent, stripping readily from the bony walls, and the ossicles in good condition.

This man's life was sacrificed by his obstinate determination not to go to the hospital, or to submit to an operation. After his return home his physician and his sons tried to persuade him to follow my advice, but without avail.

CASE 2.—Miss L. H., age 25; occupation, dressmaker. I first saw her at 9 p. m., August 7, 1903, by request of Dr. A. T. Newcomb, and the following history was obtained:

For over a year had had spells of dizziness, worse particularly the past month. One month prior to this she had fainted. For four weeks she had had a great deal of pain in her back and had been under a physician's care for sciatic rheumatism. During the latter part of this time she had been running some temperature. On the morning of August 1st she had shampooed her hair and that day some tonsilitis set in. On the fifth she called at Dr. Newcomb's office for treatment for her tonsils. That morning she had some neuralgic pains in her right ear. In the evening the pains became very severe in the ear and over that side of her head. By ten o'clock the pains had begun to quiet and the following morning the ear began to discharge some straw-colored serum. From that time on she had no more pain in her ear.

I was called by Dr. Newcomb to see the patient because of some mastoid tenderness. Examination revealed the following:

The patient was excessively nervous. The muscles of the right side of the neck were quite tender, but very slight mastoid tenderness. The external auditory canal contained some whitish flakes which were removed by syringing. The drum was exceedingly congested and thickened so that I was unable to make out the landmarks. The middle ear was full of straw-colored serum (no pus), which was removed by Politzer inflation and pneumatic speculum. This improved her hearing and made her feel more comfortable. The patient also complained of very severe pain in the back of her neck, in the cervical region, and severe frontal headache. The pupils were normal. The ear was dressed with a cotton wick containing glycerine and carbolic acid. On the following morning I learned that the patient did not sleep until about 3 a. m. She had no pain in the ear since the treatment. The cotton pad outside the wick was wet with straw-colored serum, no secretion in the canal and none came from the middle ear by Politzer inflation, or pneumatic speculum. She was complaining of intense pain in the cervical and lumber regions and also the frontal region of her head. She had some abdominal tenderness. Temperature 102.6, pulse 96, pupils normal. The patient looked very sick and was removed to the hospital for better treatment than she could receive at her home. At 2:30 that afternoon at the hospital, she seemed to be in a condition of collapse. Her features were drawn, pulse weak, temperature 103.8 (rectal). I found a slight amount of pus in the canal, from which no culture was made as the swab was lost. Shrapnell's membrane red. I performed paracentesis under chloroform, but got only blood. Under the chloroform her pulse became very weak, and it was necessary to give strychnin injections (hypodermic) and oxygen inhalations with normal salt under the breasts. She had a peculiar eruption over the abdomen and complained of intense pain in the back of the neck, lumbar and frontal regions. Symptoms now all pointed to meningitis. On the morning of the 9th, a lumbar puncture was made, showing almost pure culture of the pneumococcus, leucocytosis of 35000. In the afternon her right pupil became dilated. Death occurred at 7:30 p. m. Patient retained consciousness almost to the last.

Autopsy.—On removing the skull cap, the right hemisphere was found bathed in pus, which had traveled down the right optic nerve. On inspection, the right petrous portion of the temporal bone appeared to be normal, but on a slight tapping with the chisel the whole bone caved in, being entirely necrotic, filled with pus and granulation tissue. The mastoid was not opened, the autopsy being performed by a novice, who, in his carelessness, destroyed the petrous portion of the temporal bone, thus losing much valuable information. This patient had had no pain in her right ear until four days before her death. If the temporal bone had become infected on the day the pain in the ear began, was there time enough for the petrous portion to become entirely necrotic? Was there not rather primary osteomyelitis here with secondary involvement of the middle ear?

CASE 3 is reported in detail, as it presents some very interesting symptoms, which in a great measure deceived the physicians who were called in on the case.

I was called on the morning of January 11th, 1905, to see F. M., age 15, who was suffering from acute pain in the left ear, which had started about 2 o'clock that morning, lasting until 5, when the ear began to discharge some serum.

When examining at 8 o'clock, I found intense congestion of the drum, with bulging, a small pin point perforation at the middle of the drum, which seemed to be blocked with secretion. Under chloroform anethesia, the left drum was opened freely evacuating large quantities of bloody serum. The patient at once went to sleep and slept the rest of the day in perfect comfort, the ear discharging well.

The following ear history was obtained: He had had frequent attacks of earache, the last attack being about Thanksgiving, when his right ear ached for some little time and then discharged pus for a few days. At this time his ear was treated by syringing, but was not under the care of any specialist.

Before incising the left drum, the right was examined and some congestion of Shrapnell's membrane found. Also a slight ring of congestion extending nearly the entire circumference of the drum. He had no pain whatever in this ear, but his mother was advised to apply a hot water bag to it, which she forgot to do, as he was so comfortable. At 5 p. m. the boy's temperature was 103.3, pulse 116. Right drum not as much congested as in the morning. The left ear was discharging freely and was perfectly comfortable.

On calling the next morning, I found that during the night the right drum had ruptured without any pain or warning, discharging yellowish pus with some odor. The left was comfortable and draining nicely. Temperature 100. The patient was given calomel purging, and bichlorid douching for each ear. At 6 p. m. I learned that his temperature had been high all day, reaching 104 several times. He was free from pain, both ears discharging copiously with slight tenderness of mastoid on the right side. January 13th, temperature at 8 a. m. 101, ears discharged freely during the night, but both throbbed with sensation of dull pain that morning. I syringed ears with biclorid solution, getting away considerable secretion, with relief from pain and throbbing. Temperature reached 104, pulse in the neighborhood of 100. January 14th, his temperature kept high all day, but his ears were comfortable and discharged freely. Politzer inflation was used with good results. From this time on his ear symptoms gradually improved, the discharge grew less daily and ceased by the 25th.

On the 14th a consultation was held with Doctors King, Black, and Sherk, to discover, if possible, the cause of the high temperature, but nothing was found. The boy felt perfectly well, his only complaint being that we did not allow him enough to eat, and he continually expressed a desire for beefsteak. He was unable to sleep much after the first day of his illness. January 15th he seemed to be better, but his temperature ranged from 102.5 at 6 a. m. to 104 by axilla at 4 p. m., and at 8 p. m. was 102. January 16th, aside from his temperature, he was much better. The range was from 101.3 to 103.4. January 17th, highest temperature was 103.2, lowest 101.8. On the morning of the 18th his temperature was 100.8, but by 4 p. m. had reached 103.6.

Dr. J. M. McBride saw him in consultation, but could not account for the fever, and gave a very hopeful prognosis.

January 19th, his temperature reached 104.5 at noon, and a bath brought it down to 101.8, but it immediately began to go up, and at 8 p. m. was 104.6. At this time Dr. Hill Hastings was called in consultation to see if he thought there could be any ear complication to account for the temperature. He found the ears in good condition and apparently not accountable for the febrile condition. He, however, found some fibrillary twitching of the fibers of the pectorals major muscles on drawing the fingernail quickly across the muscle; there was also a marked Koernig. The pupils were even and active, and there were no mental disturbances of any kind. He made a diagnosis of meningitis, not of otitic origin, but probably due to an influenza infection. His prognosis was unfavorable.

Those of us who had been seeing the boy could not bring ourselves to agree fully with him in spite of the evidences of meningeal irritation. We were inclined to view these meningeal symptoms as a result of the febrile condition and not the cause. On the 20th he was about the same. Frequent baths kept the temperature under 103.5 most of the time. January 21st he was not so well. Dr. Sherk did a lumbar puncture, but failed to get fluid. His temperature reached 105, and then, on Dr. McBride's advice, small doses of acetanilid were used, and his temperature stayed at 104. His pulse all this time was about 100.

January 22d. On the morning of this day he complained first of some lumbar pain, due to the puncture of the day before. At noon there was noticed occasional twitching of the body, and that afternoon he spoke of pain in the back of his head. That night he also complained of headache.

January 23d. Early in the morning he had a nosebleed. Later he refused nourishment. He could not sleep, but was not in any pain. Later in the morning he spoke of pain first in the top of the head, then, in a few hours, all over head, and also in the lumbar region. Symptoms of meningitis were becoming more prominent, but his pupils were normal and he kept pretty rational. That afternoon he awakened from a sleep in a sort of a night terror, and it took some time to quiet him.

On the morning of January 24th there was frequent jerking of the legs and constant fumbling with the hands. He had a comfortable night, was free from pain, complained some of his back when he moved and was quite irritable when disturbed. That evening there was pain in his back, extending downward from waist line, and turning caused pain in his neck. Later that night he became irrational at intervals.

January 25th I reopened both drums under chloroform, with negative results. That evening there was some serous discharge from the left ear. He gradually became more restless, would pick at bed clothes and mutter when asleep, and became more and more irritable when awake.

January 26th, his neck was stiff and would hurt him on turning. There was a profuse serous discharge from the left ear in the morning.

January 27th, he was rational when awake, but very restless when asleep. Once in the afternoon there was considerable serous discharge from his left ear, but from this time on it was very scanty.

January 28th, he was restless during the morning. At 2 p. m. he said he was very thirsty. He sat up to take a drink of water, and after drinking said, "Why, I can't see," and fell back on his pillow unconscious. Active delirium then set in, his abodmen became distended, he voided urine involuntarily, and at 2:10 on the morning of January 29th he died.

Autopsy that afternoon by Dr. Stanley P. Black and myself revealed a rather diffuse leptomeningitis,. most marked at the base. There was no apparent meningitis in either temporal region. There was no necrosis of either temporal bone. Both mastoids were normal. The left middle ear contained a slight amount of serum. There were no evidences whatever found to lead us to think that the meningitis was of otitic origin. Cultures taken from the cerebro-spinal fluid showed the streptococcus.

XXXVII.

THE NASAL TURBINATE AS A VASO-MOTOR INDEX.

By James A. Babbitt, M. D.,

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The responsibility for physical examination in adolescence, whether general or of special senses, affords much difficulty in the determination of reliable basis for judgment. On purely morophologic lines, such standards may be readily found, and questions of defects in symmetry and posture are easily settled. Again, examination of heart, lungs and gross abdominal organs as to functional and organic integrity is comparatively simple, and in the special senses as well, gross organic defects of eye, ear, nose and throat are quickly recognized and recorded.

Aside, however, from the mere basis of cautionary advice and records of statistical and anthropometric value, many questions of vast, underlying importance rest in the examiner's estimate of the individual before him. In view of the wide variation even in the normal type, this becomes particularly difficult. The vital question at once arises as to what really constitutes a true type of bodily health. What factors add to best results, and favor general bodily metabolism; what influences lead to most natural and favorable vaso-motor action? Is this individual, and are these special senses, more or less widely differing in formation, nervous reaction, and physiologic activity, in a strictly healthy condition? If doubtful, which is cause and which effect, and where shall the foundation deficiency be located.

Laying aside the general physical problem and confining ourselves to the physical examination of certain special senses, the topic of the paper presents a field of much interest. The term catarrh, in common consideration, is inseparably connected with the nose, throat and ear, though perhaps wrongly so. Yet in spite of this limitation, it presents a wide field of correlated influence, both in its relation to the general lithemic and uric acid problem, and also involving as it does a most typical erectile surface, and performing its function as a body representative of vaso-motor change in its relation to this general system. It is the importance of this phase in general examination of the special senses, and its significance in the general bodily economy, which seem to warrant its choice for study.

Consider it, too, if you will, in its significance as to the physical condition of the growing child. First, it will be generally conceded that the catarrhal condition wherever found is a most important factor in its influence upon metabolism; secondly, the nasal mucous membrane, particularly the turbinates, are quickly affected by all special sense catarrhs. Let us consider how far, then, their condition is indicative of vital condition.

The vaso-motor system, as its name implies, includes that vast ramification of constrictor and dilator nerve fibers distributed to the muscular coats of the vessel walls, which from direct and reflex impulses practically control the action of all vital processes. Retarded blood supply practically inhibits vital activity; excessive supply produces congestion with similar retrograde results.

Starting from the vaso-motor center in the bulb, with subsidiary centers in the cord, passing out through the sympathetic system, and closely ramifying with the branches of the pneumogastric, this system of vascular nerves is practically the system in control of organic life. Furthermore, stimulation in this tract, of more than functional significance, directly produces pathologic result, evidenced by the gangrene of permanent constriction and degeneration of epithelial surfaces, following permanent dilatation.

As the functional activity of the vaso-motor system is practically limited to the arteries and capillaries, its changes are freely exhibited, and the lightning-like rapidity by which the weight of the body is changed in each consecutive moment shows its potent force. Pallor and blushing of the skin, change in surface temperature, modification in volume, rhythm and pressure of surface pulse, sensory phenomena in great variety, are all vaso-motor in result if not in origin.

Granting then, this vast underlying physiologic system, intangible and undemonstrable in accurate measure, yet perfectly in control of all organic life, it is then but fair to give this element a crowning place in the controlling mechanism of the special sense organs, which though possessing individual sensory apparatus, are yet dependent to a last degree on the general vascular mechanism for their integrity. The body economy is so perfectly correlated in all its parts, and both section and elimination so seriously affect parts most distant from those in action, that local indication of systemic influence may be safely considered. It is the purpose here to determine then, how far in a special sense physical examination, such as that of the nasal turbinates, can indicate condition of general vaso-motor action, and in this case the nasal mucous membrane is selected simply as a particularly representative vascular tissue.

In a series of diagnostic physical examinations of nasal cavity and naso-pharynx, we are probably most forcibly impressed with the turbinated features. Such examination, of course, includes careful estimate of septum, floor surface, vibrissae, superior, middle and inferior turbinates, and pharyngreat tonsil with perhaps added illuminated investigation of sinuses.

From a purely operative standpoint, possibly the condition of the septum might stand paramount, and this perhaps is seldom strictly normal, but in general judgment of the nasal cavity, and its ability to perform the functions, olfactory, respiratory, phonatory, and protective, which nature has assigned it, we study the turbinates with increasing respect.

To the novice, this routine and judgment seems trivial, but with more experience there comes with rude shock the realization of how many nasal cavities, condemned in our judgment, really afford but slight disturbance to the patient, and on the other hand of how many apparently trivial abnormalities and hypertrophies afford him genuine distress.

The subject will be carried on in these phases: (A) Classification. (B) Anatomy. (C) Group tests and statistics. (D) Deductions.

(A) Rhinitis, or more properly speaking, rhino-pharyngitis, has been broadily grouped in the following classification:

a. Simple rhinitis,
b. Hypertrophic rhinitis,
c. Atrophic rhinitis,
d. Sclerotic rhinitis(sequence of b),
e. Purulent rhinitis (sequence of c),
f. Vaso-motor conditions,
g. Specific and membranous affections,
h. Invasion of foreign bodies.

This classification, admirable in many respects, is confusing in that both hypertrophic and purulent may be specific in origin; again, the vaso-motor element, prominent in the first four groups, may still be first to reveal the presence of the foreign body; indeed, often baffled alike are both experienced practitioner and immature specialist in the diagnosis and therapeutics afforded by the complex walls of the nasal chamber. Add to this the cause and effect presented by a much convoluted and distorted septum, and the confusion is complete.

In our consideration, it is but fair to admit these difficulties; so misleading is the appearance of the nasal cavity, so frequently do gross turbinate processes produce no discomfort, and on the other hand roomy nasal passages afford such scant relief, and again so moderate are the changes sufficient to produce major obstruction, that over-reliance on surface indication is as fatal as underestimate of the same.

(B) On gross anatomy and accidental deformity, but little need be said, and passing by nasal deflection, of course a frequent cause of all the difficulty present and remediable by surgical intervention only, a nasal study naturally devolves into a consideration of the turbinated structures, the upper two springing from the inner walls of the ethmoid bone, and the lower independent, protecting the opening into the antrum of Highmore and overlapping the floor of the proper nasal passage.

In studying their structure, connection with the cerebral and sympathetic nervous system, tracing the etiology of quick vascular change and response to irritation, and again analyzing these laws of cause and effect in their relation to the adolescent period, we note firstly, that they present the most readily changeable and movable tissues in the nose, and are directly under influence of cranial and sympathetic nerves; secondly, are essentially vascular in their anatomy; thirdly, each protects openings to important sinus passages, and finally that together they perform in large part the total nasal function, both sensory and olfactory.

Anatomically (and here we must share their importance with the nasal septum) the turbinates consist of thin lips of bony shelving, curved in somewhat wood-shaving appearance, covered first by basic layers of fibro-elastic tissues in stroma containing nerves, lymphatic and glandular elements. Upon this is a membranous layer, and it is outwardly covered with ciliated epithelium interspersed with goblet cells in the lower, respiratory portion, and by non-cilated epithelium mingled with special olfactory terminals in the higher, olfactory region. The nervous supply of special sense is through filaments of the olfactory nerve passing through the cribriform foramina, and that for general sensation is derived through branches of the fifth or trigeminal, through both ophthalmic and maxillary divisions. Branches from Meckel's ganglion and the vidian nerve practically complete the group. The vascular supply forms a vast communicating series, freely anastomosing in all parts, and comprised in the main of branches from the ophthalmic, internal maxillary and facial arteries.

This anatomic summary has been hastily and briefly given, as it but indirectly affects the topic, yet emphasizes the particularly important vascular and nervous relations. Due to this freely ramifying vascular supply, we find the nasal turbinates a typical erectile tissue, freely and quickly subject to vascular engorgement, if the return avenues for such congestion be temporarily closed.

Granting the above, we summarize this situation in the nasal picture as presented:

(a) A locality freely subject to vascular congestion from whatever cause.

(b) A hypersensitive vascular area open for free and serviceable study.

(c) A locality freely subject to metabolic change. In so far as these attributes be representative of vaso-motor influence, so far may they be considered indices of the same.

Clearly the period of life, varying as it does, in which hypertrophic, or as preferred by Dr. Kyle, hyperplastic, change has become well marked, and deformities in nasal position have produced irremediable organic defects, presents no opportunity for safe judgment, but in the earlier adolescent period, a far different status obtains. Here much is in the formative stage—an application of cocain or adrenalin reveals how largely the swollen turbinate structure can clear itself from true hypertrophic stigma.

Suppose such a subject in the formative period of life were to be under examination. Nasal chambers show passages largely blocked by enormous turbinates, and this in time associated with general thickening of the entire nasal mucous membrane. By post-nasal mirror, we first attempt the elimina- of the enlarged pharyngeal tonsil. By speculum anteriorly we clear the suspicion of deflected and distorted septum, and its consequent points of pressure irritation. Polypoid degeneration and foreign bodies are next excluded, and the question of specific neuroses investigated by general symptomatology. By secondary, careful study we may perhaps eliminate true hyperplastic and sclerotic changes, and yet admit, that all these conditions are far from disassociated with the vaso-motor element, indeed, are most intimately connected with it, and must be given their place in such category.

With these functionally swollen turbinates before us still, after elimination of foreign obstruction, specific disease and misplaced septum, and reinforced by application tests of cocain and adrenalin, typical erectile tissue as it is, we have a vaso-motor focus of increasing interest and such causal possibilities as the following may present themselves in a rude way:

1. Acute rhinitis from known irritative cause. (This finally diagnosticated by accompanying symptoms.)
2. A general superficial vaso-motor dilatation from known cause and associated with vaso-dilatation throughout other parts of the body, such as blushing of the surface, frank perspiration, etc.
3. A possible evidence of general cerebral congestion.
4. A hypersensitive mucous membrane responsive to any suggestive influence encountered.
5. A congestive swelling closely following violent exercise.
6. A congestion periodic in its type.
7. Reciprocal congestion secondary to systemic illness.
8. Congestion due to disturbed metabolism.

This list might be extended, and many other vital conditions might show the metabolic relation to the general body economy. Inferences from these anatomic appearances are quickly and surely drawn.

(C) In the continuation of this topic, it having been the writer's privilege to be associated with much special and general physical examination, he would submit this preliminary report of conditions bearing upon this topic, not as conclusive in any degree, but as containing figures for further study and estimate.

In a small college near Philadelphia, a new form of physical examination and test was recently applied, one which had been recently suggested by Dr. Meylan, of New York, and in which, under a rather elaborate system, the following factors were taken into consideration: (a) Bodily control (series of four tests), one for upper extremities, one for lower, and two combined. (b) Vitality (a strictly endurance test). (c) Health (estimated one-half by examiner's grade assigned to general examination of heart, lungs and nervous system, and one-half by a series of fixed strength tests not involving coordination). This system certainly seems to be a rational one.

The opportunity had been previously taken to make special examinations of these same men as to condition of eyes, ears, nose and throat. Of these tests perhaps the most interesting was the vitality test taken under these conditions:

The candidate hung down between two parallel ropes with a known shoulder adjustment. To metronome accompaniment, once each second, he sprang to hanging position with hands opposite armpits, and then at next beat dropped to the floor, and continued this to exhaustion point. In observing these tests, fifty-one men at a given time took part, and as the age of the subjects was from 17 to 24, the sclerotic or hyperplastic turbinate was present to certain degree. Of these fifty-one men, fifteen by previous examination presented distinctly enlarged turbinates. Of this number nine men represented particularly free vaso-motor characteristics, and as to reaction time, seven would be considered of quick response, six moderate and three slow in type.

The results, meager as they are, may prove of interest, but, it is fair to admit, yielded nothing as conclusive as in tests to be described later.

Of the fifteen noted above as representing filled turbinated sacs:

1. In the special endurance test, nine were above and six below the group average.
2. In strength test, eight were above and six below.
3. In complete examination, bodily control (four tests), endurance and health (represented by physical examination and strength tests), nine were above the average and six below.

The general result then was rather in favor of men of acute vaso-motor type, but the number of candidates was too small for fair average, and the tests were non-conclusive.

A little over a year ago we made general and special examination of about 270 boys in a large boarding school near Philadelphia. Special note was made of all boys having deformed septa and enlarged turbinates.

Of this number (270), 52 were found possessing unusually large turbinates, and following the method above outlined, the writer has been investigating parallel conditions. Of this number, seventeen showed direct parallel conditions. Of this naso-pharyngeal obstruction, such as enlarged faucial and pharyngeal tonsils or thickened walls; eleven had marked manifestations of nasal septum deformity (deflection or spur). This leaves twenty-four men who might be classified as under a more or less definite vaso-motor influence, though the first group may also in part be secondary to this. In fact, three more, one from constantly recurring autumnal catarrh, and two from general systemic disturbance, might be excluded from the classified list.

Taking then these two groups, Class a contained thirty-one with distinctly causative obstruction and Class b twenty-one rather clearly vaso-motor conditions. The following estimates resulted:

1. Nineteen were classified at the time of the examination as of particularly active nervous system, nine in Class a and ten in Class b, while all but six of the remainder were put in moderately active nervous group.

2. In reaction time of the entire group, twelve showed highest response and thirty-one moderate, leaving but nine of poor reaction period.

3. In vaso-motor examination such as blushing, perspiration, general superficial temperature changes, and possibly associated pilo-motor activity, twenty-four were marked positive with the larger proportion of the remainder in the medium list.

4. In heart examination, twenty-five were recorded as perfect, twenty-three of modified integrity with slight functional disturbance, such as, hemic murmurs, nervous palpitation, or temporary dilatation, and four with a slight organic defect, more or less pronounced.

5. In general health, twenty-six were marked good, twenty moderately good or fair, and six distinctly poor.

6. As a matter of interest the scholarship question was in-

vestigated with the result that thirteen were considered good students, twenty-three medium and sixteen poor, but this seems hardly in any way indicative.

Conclusions from the above evidence are of course merely tentative and unsupported by sufficient corroboration, and averages again far too meager. They are impressive, however, and in toto present sufficiently distinct correlations to grant some deduction.

In the above statistics it will be noted that only in the first group have Class a and Class b been distinctly differentiated, and in explanation it may be said that at the time of the examination the differentiation in the remaining classes, two to six inclusive, was not sufficiently clearly indicated for announcement in this paper, and also these latter groups are included in a larger computation to be taken up later.

It seemed best to the writer, therefore, to state the averages for the present time upon the gross number of cases reported, and to submit these results as a preliminary report.

(D) Possible conclusions from the above: Granting that in the nasal cavity we possess a most highly sensitized vascular erectile organ, and readily accessible to examination, this in the early period of life is particularly sensitive to vaso-motor influences, and apparently holds a coordinated relation to general vitality and offers assistance in the gauging of metabolic change.

To substantiate this, other vaso-motor tests may be applied. A search into the general life and history of the individual indicated by these local examinations may reveal much of neurotic influence; the influence of sympathetic changes in abdominal physiology may possibly be found; again this may prove the key for the detection of associated sexual excess, or even may reveal the reflex vital disturbance from sexual irritation of deformity. In fact, redirection of the subject's entire life might in remote cases be a providential leading from studies of vaso-motor changes.

It would be unfair and foolish to place too much credence on diagnosis by isolated symptoms, yet in the search for truth we seek to attain all safe landmarks and directions leading to permanent health, and assign to that term its best and highest sense.

To the true diagostician, brawny muscular development, powerful hypertrophied heart, hypersensitive motor and sensory nerve reaction do not mean health, but far more those latent qualities of clear eye ground, soft, velvety skin, normally vascular and undisturbed mucous membranes, resilient muscular action, regularity of all secretions and excretions, deep, clear respiration, a pulse regular in volume, rhythm and vis-a-tergo cardiac pressure, indicative of strong valvular action.

Deranged vaso-motor responses are imperative, and herein lies the value of vaso-motor evidence. Its advisory indications will be both prohibitory and stimulative.

This paper is presented without apology as a preliminary report, holding no claims but those of suggestion, and it is most respectfully added to the accumulation of contemporary testimony.

XXXVIII.

POST-OPERATIVE MENINGITIS.*

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NEW YORK.

In the opinion of many otologists, the method proposed by Stacke — or some modification of it — for radically attacking the disease in suppurative otitis and in securing a permanent cure is the greatest achievement in modern otology. Its enthusiastic advocates feel that they can best describe the condition of hazard to life, to which a victim of chronic otorrhea is exposed, by saying that he is living continually over a volcano. No unbiased observer can fail to be impressed by the justice of these claims. Nor is it our purpose to attempt to diminish in one iota the praise which rightly belongs to this important procedure. It is rather to a complication, much to be dreaded, which can follow the operation—which has, indeed, followed it in not a few instances—viz., meningitis, that we desire briefly to call attention.

At the meeting of this society in Atlantic City two years ago, Dr. Wendell C. Phillips reported two fatal cases of meningitis following the radical operation. One of these may have been suffering from a latent meningitis, but certainly there was no suggestion of it on superficial examination. No record of the temperature had been taken before operation. The writer, who was permitted to see the case, cannot help feeling that the operation was directly responsible for the meningitis. In the discussion which followed, Dr. Jack recited the history of a fatal case of meningitis following in twenty-four hours the radical operation. In the same discussion, Gradle was quoted as saying that of 126 radical operations in one of the Chicago hospitals eleven, or practically 8 per cent, had resulted fatally.

A short time ago, we had occasion to investigate the otitic statistics of two leading special hospitals. In one there were records of eighty-three radical operations. Of these, ten resulted fatally from meningitis. In the other institution, seven fatal cases followed the radical operation. These figures give us pause for thought. Seventeen fatalities in two hospitals where no question can arise about the high quality of the work performed. In the one instance a death rate as high as 12.5 per cent.

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*Read at the Annual Meeting of the American Otological Society, held in New York, June 26, 1906.

Human nature is the same wherever found. No man cares to publish abroad his failures. It is impossible to say how far, if at all, these statistics are in excess of the average. Certain it is that in a diminished ratio, at least, these untoward complications are occurring every day in the hands of us all. No thoughtful man can help asking himself what meaning and weight should be attached to such results. We cannot rightly shut our eyes to them nor pass them over by a mere haphazard explanation. It cannot be gainsaid that it is just such accidents that give our specialty a black eye among the profession at large, as well as among the laity, and are the occasion of that common observation that in the case of the ear the "let well enough alone" policy is the best.

At the outset it must be admitted that a correct appreciation at the present time of the question under discussion is difficult, if not impossible. Many factors enter which are hard to justly estimate. To draw the conclusion that the radical operation is rightly responsible for a large number of fatalities due to meningitis, we must know (a) what has been the result in this respect following the long performed simple mastoidectomy; (b) how many cases, otitic in origin, occur without operation; (c) what was the condition of the meninges in the fatal cases, preceding operation. In other words, were there present signs of an already existing meningitis?

These and many other suggestions will naturally suggest themselves, an answer to which is essential for a correct estimate of the significance of post-operative meningitis. It is obvious that this can be only partially or approximately arrived at.

Acute cases demanding immediate operation do not enter into consideration here. No one can pronounce in advance positively how extensive is the involvement in such cases. We are concerned only with the chronic type, operated upon without any pressing symptoms.

As regards meningitis following the so-called Schwartze operation, it can be frankly said that it occasionally occurs. In the statistics of the Manhattan Eye, Ear and Throat Hospital, just alluded to, there are records of twenty cases of meningitis following the Schwartze operation in 1,112 operations, or one in fifty-five. Here the same rule would apply, however, namely, only simple, uncomplicated, chronic cases developing meningitis should be considered. Of these, there were only seven. How many operations there were for chronic otorrheas is not stated, nor how many had acute complications. Of the twelve fatal radicals, eight were for chronic otorrhea.

Meningitis Following Otitis Without Operation.—A second consideration in the question under discussion is, how frequent are the fatalities from otitic meningitis where no operation has been performed. It will be recognized that any exact figures in this respect are impossible. The attention paid to the ear by the profession has greatly increased and the ability to recognize and properly handle otorrhea has wonderfully improved. In consequence, the number of intracranial complications has been decreased. Yet beyond question a considerable number of such cases are constantly occurring. Many of them are probably unrecognized, or the true condition discovered after all surgical interference is deemed unjustifiable. Of such we can expect no account, whereas a fairly correct record of operative cases is possible, as they are for the most part operated upon in hospitals. Certain it is that we have a right to regard such unoperable cases as a factor in drawing our final conclusions.

Latent Meningitis.—Much more deserving of consideration is the view commonly advanced that all of these cases of post-operative meningitis are in reality cases of unrecognized meningitis at the time of operation. There is little question that instances of this do occur. All operators are not equally painstaking in their preliminary examinations. Doubtless, too, certain cases of meningitis are difficult or impossible to diagnose from the symptoms alone. Yet such cases are so rare as in no way to justify this contention. This has been conclusively shown by Zeroni (Arch. für Ohrenheilkunde, Vol. LXVI., p. 226), who has made an exhaustive study of the subject, in the course of which he collected forty cases of post-operative meningitis in which autopsies had been performed. In only three of these was there any evidence from the histories before and after the operation to show that a previous latent meningitis existed. However latent, it must be admitted that some temperature would occasionally be present, as well as other symptoms of localized inflammation. This was not the case.

The seventeen cases of which I found records do not give complete data on this point. Among them, however, there were eight following chronic suppurative otitis where such data are given. Of these, all but one were free from temperature on admission to the hospital.

Imperfect Drainage.—A far more important cause is to be found in imperfect drainage of some suppurating focus following the radical operation. The cases we are considering in many instances represent purulent processes existing for years. There are, as a rule, in consequence, extensive bone lesions. These areas have had a constant free outlet, and so the possessors have experienced little discomfort. It is the purpose of the operator to eradicate every bit of disease. This we now recognize is well-nigh impossible in some instances. Our search demands not rarely free exposure of the dura. This is not infrequently skin-grafted at the time of operation. In any case, a firm packing is applied to the entire wound. We have no guarantee that we have not after all left untouched some hidden focus of disease, and yet ye greatly hinder, if not block, all egress of discharge. What can be more natural than that under these conditions the brain membrane should receive the force of the infection!

The records of these many cases just quoted—all without elevation of temperature upon admission, show temperatures of 103° and 104° developing as early as the second, third and fourth days. This can only mean that a very weighty factor in producing post-operative meningitis is a failure to thoroughly eradicate the disease, combined with a stoppage of the previous outlet of discharge.

Faulty Asepsis.—To the previous cause, and closely connected with it, are to be linked faulty technic and imperfect asepsis. In our judgment the operation is one of the most delicate in surgery. In the hands of a beginner it cannot but be fraught with serious risk of life. The field is a deep, narrow one, surrounded by vital structures. The exact anatomy is difficult even to the experienced operator, at times. The time element in operation is no inconsiderable factor in the avoidance of shock.

Disease of the Labyrinth.—According to the statistics of Zeroni, however, the most common cause of post-operative meningitis (where the ear is considered) is disease of the labyrinth. His contribution in this respect is full and convincing. Of the forty fatal cases collected by him, twenty-nine at the autopsy showed evidence of chronic labyrinthine disease. The extent of involvement varied. In certain instances it was limited to a single area, as one semicircular canal or one window. More often there was extensive caries and suppuration of considerable areas. There was every indication that the process was a chronic one. Whether the operation served to excite an acute exacerbation of this chronic process, it is not possible in most instances to say definitely. In certain cases, however, the post-mortem evidence on this point was clear. The route of infection was determined in the majority of instances. In seventeen a perforation of the inner wall of the middle ear was discovered. The majority of these were in the oval and round window. In several instances the foot-plate of the stapes was dislocated or fractured. Less often, an opening in one of the semicircular canals occurred, suggesting the greater risk where the round or oval window was involved. In the remaining twelve cases, no perforation was recognized. How the infection entered in these cases it is hard to say. It is very possible that the perforation was overlooked. An anastomosis, pathologic in origin, of the blood vessels between the middle and inner ear can also account for it.

Of particular interest is the question: In what way is the operation responsible for this invasion? Most authorities ascribe it to the jarring effect of the mallet. That the chisel is guilty of causing harm, there can be no question. On that account certain distinguished operators never use it. But the chisel cannot be responsible for all these complications, for in two cases it was not used. In one, only granulations were curetted from the middle ear.

Zeroni admits the difficulty in many instances of diagnosing labyrinthine disease in advance. Certain characteristic symptoms, such as nystagmus and vertigo, may be lacking. But whenever it is recognized or strongly suspected, he urges that great caution be used in deciding upon operation; and when decided upon, that extra care be taken to avoid all manipulation in the middle ear. Indeed, as a general principle, he would insist that great conservatism be exercised in attacking the inner wall of the tympanic cavity, in spite of the fact that an incomplete operation may in this way be done. Especially is rough sponging to be avoided in this locality.

Jack, in the discussion of Phillips' paper, gives his opinion as follows: "The subject of the radical operation is very important, and one we should consider carefully, for some time. At present I do not think we can advise a patient in perfect health with the exception of a chronic middle ear discharge, to have this operation performed as a cure for the otorrhea without carefully considering the risk of permanent injury to the facial nerve, or of life itself."

As a result of this imperfect study, we desire to draw the following conclusions:

1. That valuable a procedure as is the radical operation upon the ear, it is as an operation by no means free from danger to life and should not be entered upon lightly where otorrhea alone is present, nor until a resort to other less heroic measures has been practiced.

2. That its most serious complication is meningitis, which would appear to be by no means infrequent.

3. A careful aural examination is imperative before operation, especially of the inner ear, as well as an observation of the patient for a sufficient time to exclude a possible latent meningitis.

4. That postoperative meningitis is due to a number of causes, of which obstruction to proper drainage of some unrelieved focus of disease and chronic disease of the labyrinth are the most important.

5. That accordingly it behooves us to exercise the greatest caution in operating for simple otorrhea when labyrinth disease is recognized.

6. And finally that especial and scrupulous care is to be exercised in every detail of the operation as regards asepsis, closure of wound where dura is exposed, unnecessary jar from chiseling and securing a complete eradication of all disease.

XXXIX.

MODIFIED BLOOD CLOT IN MASTOID SURGERY.

By W. Sohier Bryant, A. M., M. D.,

NEW YORK.

The clot has given excellent results in the hands of Blake, Sprague, Reik and many others, while a number who have tried the method have given it up on account of the infection which followed closure of the mastoid wound. More recently Blake and Sprague have reported their results of closing the mastoid wound around a small drain. H. L. Mour of Boston has used this method very successfully for nearly twenty years. The drain allows the application of the clot to a much larger series of cases than the simple clot, which is useful only in carefully selected cases. Comparatively complete surgical asepsis is not required for the wound if a drain is to be used, while it is necessary for success with the simple blood clot. This drained clot makes a compromise between the method of packing the wound and the clot plain and simple. It allows a maximum healing by first intention, while at the same time a small portion of the wound is reserved for drainage. Formerly the drainage was left in for a week or more and then removed, and the wound allowed to close.

I now practice what seems to me an improvement on this method, namely, early removal of the drain. I find that a small cigarette drain seems to be sufficiently large to accomplish the desired result of lessening infection, and its removal after twenty-four hours allows a considerable flow of serum, which is followed by closure of the entire wound by first intention. Should the wound become infected it does so early, and the opening left by the removal of the drain furnishes free drainage through the clot. I have tried this method in a variety of cases and have found it to work satisfactorily in all, as it insures a short convalescence, a good cosmetic result and decidedly better hearing than slower methods. I now use it in all cases except those where a macroscopic amount of necrotic tissue for some reason must be left in the wound. It seems probable that if the clot method were tried with our modification it would be more generally used.

My experience with this modification of the drained blood clot has been very satisfactory, even in those wounds which developed post-operative infection and the final results have been very gratifying compared with the best results by the method of packing, while the cases which are not infected heal by first intention quicker than after the simple clot and the convalescence is shorter than in the reported cases of drained clot.

Simple mastoid operations, mastoid operations with epidural or episinuous complications, and the radical operations have all given me better results, after this method was used, than they did by the simple clot or by the clot with a drain left in for some days.

Even in the cases which might have been selected for the simple blood clot, this method gave a little better result than with the simple clot itself. I have not tried it in those cases where it was obvious that all the necrotic tissue could not be removed.

In my simple mastoid operations treated by the clot dressing, healing of the post-aural wound has taken place on the average in six and one-half days. The middle ear has been dry in thirty-seven and one-fourth days. Treated by our modification of the drained clot, the healing of the post-aural wound has been complete in five and one-half days and the middle ear dry in eight days, which makes the proportion six and thirty-seven to five and eight for our method. This shows a decided advantage for our drained clot.

In the radical operations treated by the clot dressing the post-aural wounds have healed on the average in ten days, while the middle ears have been dry in twenty-one and one-half days. The average result of cases of radical operation treated by our drained clot shows the healing of the post-aural wound in nine days and the middle ear dry in twelve days, making the proportion of ten and twenty-one to seven and twelve for our method. This shows a decidedly better result than by other methods.

Cases of epidural abscess do not indicate the use of the simple clot dressing, but they do very well with the drainel clot. The cases treated by our drained clot, on the average, had the post-aural wound healed in fourteen days, and the middle ear dry in seven and one-half days.

Illustrative Cases:

Case I is a case of uncomplicated mastoid operation which might have been treated by simple clot. It shows a very satisfactory result under the use of the drained clot. The operation was done on a child for acute mastoiditis. A cigarette drain was inserted and the wound allowed to fill with blood. The wound was healed on the second day, except at the exit of the drain, which was then removed. The middle ear was dry on the seventh day. The highest temperature after the operation was 99.04° per rectum on the day after the operation. The cosmetic result is perfect.

Case II is a case of uncomplicated mastoid operation where the simple blood clot was contraindicated because of the extensive involvement of the parts which it was not expedient to wholly remove. It shows a good result with our drained clot. The patient was a child with a large subperiosteal abscess and acute mastoiditis with extensive involvement. The wound could not be excavated till healthy bone was found in all directions. After the operation the wound was flushed with salt solution, a cigarette drain inserted and the wound allowed to fill with blood. The meatus was packed with gauze. The temperature was normal after the operation. The drain in the wound and the gauze in the meatus were removed on the second day. On the eighth day the wound was healed completely and the middle ear dry. The cosmetic result was perfect.

Case III. The patient was a young woman with chronic middle ear suppuration and tympanic caries. The usual radical operation was done. The dura was uncovered over the knee of sinus and antrum. The wound was flushed with normal salt solution. A small drain was placed in the lower angle of the wound which was closed and allowed to fill with blood. The meatus was lightly packed with iodoform gauze. On the next day the gauze drain was removed from the wound. On the sixth day, the post-aural wound was healed and the middle ear was perfectly dry. The highest temperature was reached the first night, 100 6-10°. The cosmetic result was perfect.

Case IV. A case of mastoid operation complicated by a large epidural abscess and erosion of bone treated with our drained clot. The recovery was rapid. The patient was a young man with acute middle ear suppuration, mastoiditis and epidural abscess. The usual mastoid operation was done. The dura mater, posterior to the mastoid antrum, was found covered with granulations and the inner table of the bone deficient over a large area. The wound was washed with salt solution.

allowed to fill with a blood clot. The meatus was packed with iodoform gauze. The highest temperature, 100°, was reached in the first twenty-four hours. The day following the operation, the drain was removed from the wound and the gauze from the meatus. On the 15th day, the membrana tympani was healed and perforation closed. The post-aural wound was also closed and completely epidermatized except a tiny spot at the former seat of the drain. The scar is very small and the post-aural surface almost perfectly smooth.

Our modified clot offers many advantages which are sufficient to warrant its trial even by the practitioners who have not met with success after using the simple blood clot.

DISCUSSION.

Dr. W. C. Phillips, New York, said that so far as his experience was concerned and knowledge of the work as it was done in New York in the large hospitals among the ward patients, all attempts at rapid healing by means of blood clot in any form had met with almost invariable failures. He has been surprised at the cases reported by men in other cities, especially those of Sprague and the men working in Boston, because the results among the class of outdoor patients that are found in the great metropolis are not good. Whether it is due to faulty technic or not he was not prepared to say. It did not seem possible to sterilize absolutely such a field and retain it so, and keep a blood clot clean and free from infection. The wound always communicates with the middle ear, giving two sources for infection. He was very skeptical and hardly thought the operation a fit one for general adoption.

Dr. E. M. Holmes, Boston, was very much discouraged with its use. It has been his experience in Boston that they resulted badly whether they were in or outside, and yet Dr. Bryant's suggestion was a new one. He thought perhaps he might have another opportunity to try it with the modification of a cigarette drain. With acute cases there seemed to be the same opportunity to make the same opening for flap operations, and if there was any method by which convalescence could be shortened, he would be glad to avail himself of it.

Dr. W. C. Bane, Denver, said, in his limited experience with the blood clot in mastoid wounds, he had found it unsatisfactory. The wound became infected and had to be cleaned out. There is nothing to be gained by its use.

Dr. W. S. Bryant, New York, closing, said that the chief points in the technic were to watch the convalescence and fairly good results were obtainable. He thought the reason failures were so frequent in New York was because the dressings were usually given over to the internes who were not as careful as the operator. He suggests taking out the drain in 24 hours. If suppuration should occur he advises a free opening. He expected healing to occur by first intention even with a drain.

XL.

THE MEDICAL TREATMENT OF TUBERCULOSIS OF THE UPPER AIR PASSAGES AND THE EAR.

By Wm. C. Bane, M. D.,

DENVER.

The medical treatment is naturally considered under two heads: constitutional and local.

1. *Constitutional:*

Theoretically, much might be hoped for by systemic medication, but, unfortunately, comparatively little is accomplished. New remedies are brought to our attention from time to time, and lauded as cures of the white plague, only to be found wanting when put to the test. The drugs that aid in stimulating the appetite for food, and the enriching of the blood, do accomplish much in assisting nature in overcoming the disease. Experience has demonstated that strychnin is the best stimulating tonic for tubercular patients. The hypophosphites have some value, and may be combined with strychnin.

Certainly the most efficient destroyer of the tubercle bacilli is rich blood. Hence the importance of a full nourishing diet of meats, eggs and milk, supplemented with emulsions and fats. Creosote and guaiacol have a value in stimulating an appetite and toning up the system. They may be combined with malt or some of the oleaginous preparations. Calcium chlorid is given by some physicians with the idea that it has a beneficial effect in overcoming the disease.

Forced feeding, coupled with rest to the system, is very important in aiding nature to combat the disease. The cough should be kept in abeyance in order to give rest to the diseased parts, particularly the larynx, and this is best accomplished by some of the alkaloids of opium, as codein or heroin. Not only does the codein quiet the cough, but it aids very materially in relieving the pain, both very important points in the treatment.

2. *Local:*

The local treatment of tubercular laryngitis depends upon the stage of the disease and the amount of destruction that has taken place. Likewise, upon the object aimed at, i. e., whether palliative or curative. In the far advanced pulmonary cases, with markeed destructive changes in the upper air passages, but little more than palliative treatment is to be considered. But in the cases of infiltration, or even ulceration, with fair condition of the lungs, vigorous efforts should be put forth to check the local disease.

Whether the disease be in the nose, pharynx, larynx or ear, it is desirable to keep the surfaces as free from mucopurulent secretion as possible. As a cleansing solution, and at the same time possessing some anesthetic properties, I am partial to a 4 per cent solution of resorcin. It can be used freely by the patient at home.

A 1-1000 solution of alphozone is an excellent preparation for cleansing the larynx. Being germicidal and but slightly irritating, it can be used freely.

The most efficient remedy up to the present time is formalin, whether in the filtrative or ulcerative stage. It is irritating to some patients, but the irritation is only transient. Formalin is decidedly germicidal in even a weak solution, and serves for not only cleansing the larynx and pharynx, but in a comparatively strong solution, 1-500 to 3-100, for direct application with a swab to the diseased areas. In most cases the formalin, in strong solution, should be preceded by the application of a 5 to 10 per cent solution of cocain or eucain B. A 3 to 5 per cent solution of formalin has a decided beneficial action on ulcers of the larynx, and may be applied to granulations about the epiglottis and vocal cords. It causes shrinking and hardening of the tissues, thus encouraging fibrous changes.

Lactic acid is a local remedy of value in the ulcerative stage when it is desirable to destroy tissue. Dr. L. B. Lockard* of Denver has had a very large experience with the local use of formalin in tubercular laryngitis, and he regards it as superior to all other remedies. I wish to state in this connection that I am indebted to him for his views on the treatment of tubercular laryngitis, and have embodied some of them in this paper.

The essential oils have some value, yet when used in sufficient strength to avail much, they act as irritants. Their principal value is in overcoming the fetor, in part.

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*The Laryngoscope, October, 1904.

Possibly the best instrument for the patient to use for cleansing the nose and throat is the Devilbiss No. 16. It is easily handled and can be readily sterilized.

For local anesthesia, there are several drugs at our disposal. Eucain B in a 5 per cent solution has a good effect and interferes less with local nutrition than cocain. It is less toxic than cocain. A safe and most efficient local anesthetic is orthoform applied by insufflation with boric acid, or in an oil. Dr. Lockard recommends a mixture of orthoform, viz.:

Orthoform .... grs. xv.
Menthol .... dr. j.
Ol. olive .... oz. j.
Inhale for 5 or 10 minutes every 2 to 5 hours.

The medical treatment of nasal or pharyngeal lesions is that outlined for the larynx. Where the tonsils are involved it is necessary to swab out the crypts thoroughly with a solution of formalin or lactic acid. A very strong solution of alphozone also meets the indications. We perhaps pay too little attention to the tonsils in tubercular patients. It is certainly true that one source of involvement of the cervical glands is through the tonsils and connecting lymphatic vessels.

The ear is invaded insidiously, and as a rule without pain. Too much care cannot be taken to prevent the tuberculous mucus from entering the Eustachian tubes. The manner in which many people blow the nose tends to force the infected mucus into the tubes. The cleansing of the vault and nose with a germicidal spray is very desirable to avoid involvement of the ears. In the early stage or that of infiltration and maceration, the hearing being impaired, and a full feeling experienced, without pain, the patient seldom applies for aid, except when one ear has already been damaged. In this stage an effort should be made to empty the tube and middle ear by suction and medicated vapor, as of iodin and methol, gently forced into the middle ear. After rupture of the membrana tympani has taken place, it is desiraable to keep the canal and middle ear as dry as possible. The patient should be taught how to dry the ear with cotton on a cotton holder. Once every second or third day, the canal, ear and tube may be treated by instillation of a 3 per cent solution of formalin, preceded by a 5 per cent solution of eucain B. I do not favor frequent irrigation of the ears in these conditions. They do best under a comparatively dry treatment. The long and faithful carrying out of the above line of treatment will bring about a dry condition of the ear and check the tuberculous process, if the general condition of the patient has improved. The hearing is usually permanently impaired.

In Colorado, we see a class of patients that are practically well of their pulmonary disease, yet in whom the hearing in one or both ears is impaired. The drum membranes contain one or more perforations of varying size. There is a varying amount of secretion that is thrown out from the middle ear and dries on the edges of the perforation, and in time covers it. These patients consult us at irregular intervals to have the dried masses removed. When left too long, maceration beneath the mass occurs and the ear becomes foul. We find it best, as a rule, to loosen the edges with some form of liquid before attempting removal. The instillation of eucain B followed by formalin, will in time check the secretion and effect a cure.

Occasionally the subacute destructive process progresses and there results a loss of the lining of the middle ear and necrosis of the promontory. The medical treatment in such cases is mainly that of keeping the parts clean.

When the disease invades the mastoid much can be accomplished by irrigation with alphozone, and the external application of ichthyol and glycerin. While I have seen a goodly number of tuberculous ears, the cases with pronounced involvement of the mastoid have been very few, indeed. Not over 3 per cent of my operations for mastoiditis have been on cases of tubercular origin.

XLI.

THE CLIMATIC TREATMENT OF TUBERCULOSIS OF THE UPPER AIR TRACT.

By Wolff Freudenthal, M. D.,
NEW YORK.

It is an old and common experience that the majority of pathologic conditions are beneficially influenced by pure, fresh air. More difficult, however, is the answer to the question: in what affections can a marked relief or cure be expected by a change of atmospheric surroundings? The disease of interest to us in this discussion is tuberculosis of the upper air tract. Since we cannot separate those parts from the rest of the body, we should not ignore the condition of the lungs, which, as a rule, are also affected. On the other hand, it is my conviction, based on a considerable experience, that the diseases under consideration require a special climate in some instances.

First of all, it must be borne in mind that tuberculous cases are being cured in all parts of the world, i. e., in every possible climate. Still the difference, for example, between a high altitude and the seashore is so great in a physiologic sense that in pathologic conditions a beneficial or a deleterious influence might be expected from either of these localities; and, as a matter of fact, such influence for better or worse does exist under different climatic conditions, for you will all agree that some of your patients have done well in southwesterly altitudes, while they become worse when they return to their homes in the East. Why is it that these relapses occur so frequently? Is it because these people resume their old occupations? No! Some of them — women — have no vocation, while others follow their business in the West for many years without detriment. This is undoubtedly due to the influence of the climate, and in the following pages it shall be my aim to discuss briefly the treatment of tuberculosis of the upper air tract from a climatological view-point.

For the sake of convenience, I have thought it best to divide the subject into four parts:

(*a*) Aerotherapy.
(*b*) Heliotherapy.
(*c*) Altotherapy.
(*d*) Thalassotherapy.

(*a*) *Aerotherapy* is the treatment with fresh, pure air, which a priori we should be able to utilize everywhere, and in fact we do make use of it all over the world. What diet means in catarrh of the intestinal tract, aerotherapy means in catarrh of the air passages (Nothnagel); or, we may add, in tuberculosis of the air passages. If we take a patient away from his sweatshop, direct him to do half a day's work if he cannot give up work entirely, and let him spend as much time as possible in some park in the open air or, in smaller towns, in the fields, such a patient has actually changed his climatic surroundings. If necessary, his throat and nose can be treated at the same time, and in a number of cases we will be rewarded by a cure.

If the patient is somewhat better off and can stay away from business for several months, so much the better for him. We can then place him in a sanatorium nearby, or he can present himself at regular intervals for treatment. By far the great majority of all consumptives must be treated in that way, and I am sure there is not one physician in the United States who has not obtained cures in that manner.

The details of using air as a therapeutic means in tuberculosis are so well known that I need not dwell on this topic any further. However, let me ask you not to go into fads. The following case may illustrate what I mean: A well-nourished gentleman commenced to cough, and a diagnosis of incipient tuberculosis was made. Consequently he was ordered by his physician to stay in bed on a strict diet, to be massaged three times a day, and directed to have a tent built on his house opposite Central Park, in order to obtain more fresh air. These orders were carried out strictly for a week, when this gentleman and his wife were so exhausted from excitement, worry and lack of sleep that they told me they could not stand it any longer. On my examination, the condition of the lungs gave a reasonable doubt as to the correctness of the diagnosis, but there were present marked pharyngitis and laryngitis. I told the gentleman to eat whatever he wanted, to be out all day long and to have his throat treated. After eight weeks he had gained ten pounds in weight, and, having settled his business affairs, I sent him to the mountains. His cough had left him long before. I am convinced that this patient would have gone rapidly into consumption if the former method of treatment had been continued.

It is very true that a consumptive cannot get too much fresh air, but to suddenly transplant a person susceptible to drafts from a hot room in New York City to cold winter air day and night is irrational, to say the least. On the other hand, even in the best of climates patients often do not get enough air. Some people think that when they live in the open air while taking the rest cure, they have done enough. As you know, however, the gaseous exchanges are only partly carried on by the lungs, and a great deal is done by the skin. Hence, we ought to expose the skin as freely as possible to the air, since parts of the lungs are out of function. A sojourn outdoors brings one in contact with the movable air, which is an essential factor in stimulating the skin, and through it the organism, to renewed activity. This is also the reason why we should accustom our consumptives slowly to wearing as few garments as possible, and finally to take air baths with the naked body. With this we have reached the second part of our discussion.

(*b*) *Heliotherapy.*—The therapeutic use of the rays of the sun is older than medicine, but their action on the human organism has been explained scientifically only in late years. I need but mention the names of N. R. Finsen, W. Gebhardt, Möller and Schönenberger, and they will bring to your memory a great deal that has been achieved in that field.

While the direct rays of the sun have been chiefly employed in order to promote perspiration, nowadays a combination of the diffuse sun rays, with exposure of the naked body to the air, is being utilized with success. By exposing the whole body to the air not only is the exchange of gases through the skin accelerated, but at the same time, through the action of the sun, the metabolism is increased and finally a beneficial influence is exercised upon the nervous system.

Says Prof. Rieder of Munich: "The question has been brought up whether it would not be preferable to let the patients go around naked in glass houses, instead of subjecting them to the fresh air cure, as is customary in sanatoria." This question has been answered in the affirmative by others, and I am personally very much in favor of such a combination, only I should advise that this cure should be carried out in the open air instead of in glass houses, as Rieder suggests (Handbuch der physikalichen Therapie von Goldscheider and Jacob, Bd. ii., p. 502, etc.).

That we can also use the direct rays of the sun for this treatment, I have mentioned on various occasions. Permit me only to repeat that one of the first directions I give to my patients is to stay in the sun as long as they possibly can; that is, in winter. In summer they are advised to rise with the sun and expose themselves to its rays. In warm climates, as well as in our own, this has to be done later in the day with more care and judgment. But even in the hot regions of Colorado, New Mexico and Arizona I have had patients working on ranches for many hours every day and they fared well. But not everybody can stand this, and we have to discriminate here as in everything else in medicine. We should remember that exposure to the sun does not act therapeutically through its intensity, but rather through its continuity. Too much exposure has a weakening, deleterious effect, and spoils the appetite, but taken in the right way it has done good in a general way. As to treatment of the upper air tract, I have noted some good effects in so far as relief of pain is concerned. As a substitute for the sun, the arc light has been used, and while it is not a panacea, it is nevertheless a good adjuvant to our armamentarium in such treatment.

(*c*) *Altotherapy.*—I have coined this word myself—at least, I do not remember having read it anywhere—to indicate treatment in high altitudes This treatment is of great, if not of paramount, importance to our tuberculosis patients. There are four features which characterize high altitudes:

1. The pressure of the air. This being highest at the level of the sea, gradually diminishes with the altitude, and with it likewise the density of the air.

2. The intensity of radiation of the sun. This (i. e., the rays of heat), on the contrary, increases with the altitude and level of the sea, gradually diminishes with the altitude, and independently of the heat of the ground.

3. The rays of light. Their intensity is also increased, and, according to Prof. A. Loewy of Berlin, it is especially the chemical, short-waved rays—the blue and violet—which are present in high altitudes and make themselves felt more strongly than at the level of the sea.

4. The temperature of the air. This diminishes with the

elevation. Of course, that varies with the geographical latitude, and is due partly, as we know, to the decreasing density and diminished humidity of the atmosphere.

Now these atmospheric conditions prevailing in high altitudes have a more than merely perceptible effect on the human body under normal conditions. Can we believe that they are negligible in pathologic processes? We know that good work is done in sanatoria situated at the sea level, but does this imply that climate as a factor in the treatment of tuberculosis can be ignored entirely? If our home sanatoria were less careful in selecting by preference incipient cases or such where the diagnosis is still in doubt, one would see how quickly the mortality would rise. I have advocated the erection of sanatoria in and near New York, myself, and I know that for cases with slight local lesions, cases which are quite well nourished, they fill a great need. On the other hand, cases with marked anemia, febrile temperatures and irritations of the mucous membranes do much better in the mountains. This is also the experience of A. Fraenkel of Berlin (see his excellent work on Lungenkrankheiten, Berlin, 1904). Patients with much expectoration from the lower or upper air tract should be sent to a dry climate; while others, with a dry, hacking cough, do better in a moist climate.

In most of the text books, it is stated that tuberculosis of the larynx or pharynx is a contraindication to a sojourn in high altitudes, as it is a complication of pulmonary tuberculosis that retards or prevents the cure of the latter in these altitudes. Such and similar statements go from one text book to another and are accepted as truth. They are certainly not in accordance with my experience. Among my patients, there are some now living in New York City in good health and following their occupation for the last five and even ten years, who have been suffering from pulmonary and laryngeal tuberculosis (one with deep ulcerations in the lung). They were sent by me to Denver, Colorado Springs, parts of Arizona and New Mexico, and were perfectly cured there in spite of their laryngeal affection.

The trouble is that a great many of these cases represent an advanced stage of the disease, with a derangement of one of the vital functions of the body, namely, digestion. I say digestion purposely. The tuberculous involvement of the larynx only in extremely rare cases interferes with breathing,

i. e., with the respiratory tract; but too often when dysphagia is present it interferes with nutrition. Now to send a patient to a high altitude who has been debilitated by lack of food, whose heart is fluttering with every movement and who has not sufficient vitality to become acclimated to the new surroundings—that is like stretching a piece of rubber to see whether or not it will break.

On the other hand, there are quite a number of those afflicted with laryngeal tuberculosis who have enough vitality and energy to become accustomed to new surroundings, whose hearts will do this somewhat increased work without any damage, and whose dysphagia can be kept under control. Many of these will derive a great deal of benefit from a stay in high altitudes. Persons suffering from dysphagia should be sent to some place where there is a laryngologist who knows how to handle such cases. It is not at all to the credit of some sanatoria that they neglect the treatment of the larynx almost entirely, and it is not a rare exception for a patient to complain of pain in his throat and be told that he has a cold. It is true that we cannot cure all these cases, but it is only a short time since, while I was preparing this article, that a patient came back from a well-equipped sanatorium in the mountains because no attention had been paid to his throat. He had ulcerations on the epiglottis and on one vocal cord, besides infiltrations of the other cord, and interarytenoid spaces. By local applications these ulcerations soon healed, fortunately, and the patient could take his food without the slightest difficulty. Then I sent him back to the mountains. The infiltrations are there yet and he is hoarse, but that does not bother him. He has better chances for cure now than before.

Cases of tuberculosis of the upper air tract in many instances not only requires high altitudes, but often also a mild climate. This is another fact that apparently has been forgotten of late. A wind blowing at the rate of forty or more miles an hour is not good for many of our patients with involvement of the upper air passages. They have been compelled to return from some well-known sanatoria in the Catskills and Adirondacks and have done better in some of our southwestern states. It is remarkable how much cold and how much wind some patients can stand, but there is quite a proportion who cannot stand this, and they do better elsewhere.

Robert Levy of Denver,* who has an exceptionally large experience in this field, attributes much therapeutic effect to the climate of Denver. In his statement others apparently agree with him, as for example, George L. Richards of Fall River, Solly of Colorado Springs and William Duffield of Phoenix, Arizona. I have reported my observations on the climate of the southwest some years ago (*N. Y. Med. Journal,* March 25 and April 9, 1898) and still hold the same views, believing that some persons will do well out west who have no chance of living in our New York climate.

(*d*) *Thallassotherapy.*—This is the treatment of patients by means of sea baths and sea air. The first will not be discussed here, since enough has been written on that subject in general. I would only add that tuberculosis in my experience is no contraindication to sea bathing. The same holds good for tuberculosis of the upper air tract, with but one exception, viz., when the salt water produces an irritating cough. In such an event it should not be allowed, but I must say that these cases are rare and that many paients take sea baths with good results when they are careful not to swallow too much water. Bathing and swimming have to be regulated as any other exercise on land. Too much of it may do harm, while if moderately taken and increased slowly it may do and has done a great deal of good. After the bath, the patient should react quickly and soon feel warm. If he is blue after coming out and a comfortable feeling does not set in promptly, sea baths should be prohibited or postponed until he is stronger.

The Treatment of Inhaling Sea Air. This is one part of our therapeutics that has been neglected in the United States until almost this day. When, years ago, I sent patients with tuberculosis in winter to Coney Island and neighboring places, one of our best laryngologists made fun of it. Nowadays, we have already advanced so far that we have a sanatorium for sick babies there, and it is doing good work.

And why not? I ask. This section, i. e., the southwest shore of Long Island, is to some extent protected against the cold north winds of the winter. If the sun is out with a south wind, it is much warmer there than in the city, and the patient is able to obtain the great benefit of the sun, and absolutely pure sea air. Is that not doing a great deal to stimulate the organism to renewed vitality?

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*Laryngoscope, p. 763, 1902; and Jour. Am. Med. Ass'n, p. 707, September 16, 1899.

Another point is sea voyages. It is almost more than strange that we who are surrounded by water have not thought more of sea voyages as a means of restoring health. But it is perhaps that the nearest and most natural is overlooked. *Lucus a non lucendo.* The English have a large experience in that respect, and lately such a place has been proposed in Germany also by Nisser, v. Leyden, v. Bergman and Sobotta. I believe that such floating sanatoria would be of great benefit to our consumptives in this country, provided that vessels are built with all the conveniences and sanitary arrangements necessary for the care of such patients. A great deal of good could be done to quite a number of sufferers, provided they are selected with proper care. Such floating sanatoria could be used easily in the vicinity of New York during the summer months.

In conclusion, I would emphasize strongly the necessity of giving our tuberculous patients the benefit not only of medicinal and surgical, but also of climatic treatment. If after thorough trial a patient does not do well in one climate, he should be sent to another. But do not let us become pessimistic after having tried one specific kind of climate or treatment without success. Whatever be the method of treatment, the physician must always maintain a spirit of optimism which will be an inspiration to himself and the patient.

DISCUSSION.

Dr. James E. Logan, Kansas City, in opening the discussion, emphasized the fact that whether tuberculosis be general or be entirely of the upper air passages, it varies so much in different parts of the country that it is hard to give any specific outline of treatment, or any reliable statistics refereable to the results obtained. The cardinal principles to be observed under all conditions is that of maintenance of the general systemic condition. Results of treatment of laryngeal, aural and nasal complications depend largely on the condition of the patient. His experience in his own locality is that a large portion of the year is very acceptable, where the environment of the patients are good. Dr. Bane had referred to the local application to the larynx of formalin, lactic acid, resorcin and idoform; Dr. Logan mentioned iodoform simply to condemn it, as it was so irritating to the trachea, producing a troublesome spasmodic cough. He sometimes used iodoform in pharyngeal ulcerations. Dr. Levy had brought out, in a very lucid manner, the surgical proceedings to be carried out in the treatment of laryngeal and pharyngeal conditions. The speaker wished to emphasize one very important point, viz., in all cases of tubercular otitis media there should be a careful examination made of the vault of the pharynx. Most patients suffering from tubercular inflammations of the upper air tract exhibit fragmentary and degenerate adenoid vegetations. The speaker has seen many such cases, and invariably removes these masses. This is especially a point of interest in all cases of aural complications.

He has seen many such cases recover from the aural disease by this operative interference. Dr. Levy mentions deep incisions into the structures involved—the experience of the speaker was not favorable to such procedure. He believed that the destructive process would be hastened if this plan of treatment be carried on in localities where tuberculous diseases were contracted. He has refrained from making these incisions, in the light of his own experience. He removes at all times all that he can of the epiglottis, whenever it is the cause of pain or prevents deglutition. Curetting of the tuberculous ulcer, followed by a 25 or 50 per cent solution of lactic acid was his favorite plan of treatment. The speaker's results have not been so flattering nor so happy that he would not prefer sending them to a beneficial climate. In the climate surrounding Kansas City it is impossible to put patients outdoors. A great benefit was to be derived from outdoor life, athletic exercises and a generous method of feeding.

Dr. W. C. Phillips, New York, said that every phase of this symposium was bound to be of great interest to all because it represents the most common of all serious affections of the upper air passages, and because of the extreme difficulty presented to the surgeon in every case. Regarding tubercular manifestations of the ear, he had no doubt that a considerable percentage of chronic purulent affections were tubercular; that it was difficult to make a diagnosis positively of tuberculosis of the ear, as microscopic examinations of the discharges did not reveal the tubercle bacillus. Never could it be positively made except by pure culture. The same holds good as to the extension of the tubercular process in the accessory spaces connected with the tympanic cavity. There was no reason why the process should not extend, and the nature and character of the surface which was involved would encourage an extension to the cells of the mastoid process and the epitympanic space and on through to the brain. There were many cases, . no doubt, of tubercular meningitis that have come through the ear. As to treatment in ear cases, the most radical surgical measures should be adopted, the results being invariably good, unless in far advanced general tuberculosis. The chief dangers were the impossibility of removing the last vestige of the process. In advanced general tuberculosis, soon to be fatal, it is wiser to leave the ears alone. As to the treatment of tubercular ulcers involving the larynx and pharynx, the results in the New York climate were so bad that surgical treatment was attempted with but little hope of success. He has never seen a case involving the vocal cords, the epiglottis, the false cords and the arytenoids recover. They are always, in the speaker's opinion, fatal. In one marked case of tuberculosis involving the base of the tongue without involvement of the epiglottis or larynx, but with the lungs involved, thorough curetting was employed on several occasions, together with all the usual medicinal applications, yet the case went steadily on to fatal termination. Extreme care should be used in advising a patient to go away from home with a false hope of trying to recover from a fatal tuberculosis.

Dr. H. Bert Ellis, Los Angeles, was much impressed with the enthusiasm of the different writers. He thought that if the diagnosis is made early, the local, surgical or climatic treatment would give favorable results. If serious involvement of the larynx or pharynx is present, little hope should be held out. He had the same experience with incision as did Dr. Logan; it made the patient worse. When the speaker now sees a case of serious tuberculosis of the larynx with considerable infiltration, he feels tolerably certain the patient will die within six month to a year. He depends entirely on fresh air out of doors, stuffs the patient with eggs and milk, and gives up all local treatment. He has two patients at the present time where there was almost total destruction of the vocal cords, and the false cords were much infiltrated, the epiglottis three times its normal size, and the patients were scarcely able to breathe; these two patients were sent to the desert, and after being there a year, the ulcers had healed. The patients are practically well as long as they remain in the desert. Operative interference on the pharynx and larynx, in the speaker's experience, usually makes the conditions worse; however, to relieve the pain, portions of the new growth can be removed with advantage.

Dr. H. W. Loeb, St. Louis, said that operative treatment in these conditions appealed to him from a different standpoint from what it had years ago. He then did some considerable operating with some improvement and eventual death, with slightly increased length of life and slight decrease in the severity of the symptoms. He then took the position that operative intervention was without avail. One patient was treated without operation and he lived seven years and finally died of tuberculosis of the lungs. Two years ago, when he visited Denver, he changed his mind in regard to the results of operation, because he saw laryngeal tuberculosis in which operations had been performed and good results had been obtained. They were sufficient to convince him that a tubercular patient had a better chance by being sent to a proper climate and to a competent laryngologist. He thought we should be more optimistic and any improvement should be accepted with satisfaction. He had found orthoform quite irritating; he now uses anesthesin.

Dr. E. M. Holmes, Boston, reported a case ten years ago of a man who had traveled all over the west and then came east. He had extensive laryngeal ulceration and looked as though he would be unable to live very much longer. His physician had him on the roof of a piazza, and he obtained some relief from lactic acid. That man is now alive and carrying on business actively in Brockton, Mass.

Dr. W. S. Bryant, New York, said that otitis of tubercular origin in his experience and that of others results nicely after surgical intervention, so much so that it seemed much earlier indicated in tuberculosis. Healing seemed to be quite as ready as in those conditions which have no tubercular symptoms. The question of diagnosis he thought a rather delicate one, because of the inability to obtain the bacilli by microscopic test, but the clinical course of these cases, with destruction of tissue and low grade inflammation, was diagnostic.

Dr. Kaspar Pischel, San Francisco, drew the attention of the members to a paper soon to appear in the *California State Medical Journal* by Dr. Max Rothschild as to intravenous injections of Koch's tuberculin. The paper was to have been read at the recent meeting of the State Medical Society which was interrupted by fire. It is a preliminary report of about twenty-five cases with some marvelous results. Dr. Pischel mentioned one case of tuberculosis of the larynx in which the ulcers healed so quickly under the intravenous injections and local treatment with lactic acid that it could hardly be attributed to the local treatment alone.

Dr. Robert Levy, Denver, in closing the discussion, said there were some important points to consider. During the past few years he had arrived at a uniform basis as regards surgical treatment in these cases. He does not believe in advocating enthusiastically all surgical measures, but he believes there is a rational middle ground for this treatment. It was unquestionably true, he knew, that there were many cases of spontaneous cures of laryngeal tuberculosis; the literature was full of them, and they were heard of at every meeting. That the general or climatic, or any one treatment was responsible for this, one cannot affirm. It was a question of adoption of methods of treatment in the hope that because it was known that spontaneous cures occurred, that treatment would assist in this cure. The relief of the symptoms alone is sufficient to warrant treatment, for life may be prolonged by adding to the patient's comfort. He thought also that as to climate it was altogether a question of altitude. He believed, as Weber had pointed out, it was a question of fresh and pure air. As to the ear, he has observed local conditions improve while the general condition has remained the same or grown worse, and, per contra, suppurative processes have often begun in the ear when the patients were comparatively well. As to the diagnosis of tuberculous ears by bacterial examination, it was pointed out by Wingrave that the difficulty in discovering the bacillus was often due to the difficulty of procuring the specimen from the proper place.

XLII.

ASPIRATION OF THE TYMPANIC CAVITY IN OTITIS MEDIA.

By Percy Fridenberg, M. D.,
NEW YORK.

A truism of metaphysics compares human progress to a spiral which at certain points returns upon itself before again advancing, rather than to a straight line of uninterrupted advance. The last decade has seen notable improvement in the technique of aural surgery, in the recognition and management of the otitic cerebral and vascular complications, and in the prophylactic therapy of the nose and naso-pharynx. Of late, we seem to have come to an end of innovations and explorations and to be devoting more attention to some well-known parts of the domain of otology with a view of possible improvement in method. In this connection I may mention the blood clot dressing in the attempt to obtain early closure of the mastoid wound, and the treatment of middle ear and mastoid inflammation by local hyperemia, the congestion treatment of Bier. There is still some doubt as to the former procedure being based on sound principles of surgery and quite decided doubt as to its practicability. The first reports in regard to Bier's treatment were uniformly favorable, and those from the surgical clinic at Bonn, as might have been expected, quite enthusiastic. A more general trial of the congestion-method in other institutions and countries resulted in a less unanimous verdict, and now we are beginning to hear of the failures and dangers of the procedure. Whatever the advantages of constriction and hyperemia may be in inflammatory disease of the limbs and joints, or of the skin, I think that it is a very dangerous and objectionable form of treatment for otitic disease. The prime requisite it seems to me, is free drainage, especially in acute cases, and any interference with this process is intrinsically and radically wrong. In acute otitis media we perform paracentesis as soon as we have evidence of an exudative inflammation in the middle ear, and encourage the discharge of infectious material by gravity, heat, irrigation, in fact, by every means in our power. This subject is at least as important in the end as sinus thrombosis and brain abscess, for rational treatment of middle ear disease, and incidentally, let me repeat, of naso-phayngeal catarrh and hypertrophy, represents the stitch in time which saves, not only stitches nine, but life as well.

There is a perfect chain from adenoids to acute otitis, to mastoiditis, to thrombosis, labyrinthine suppuration, meningitis or abscess, and while I do not wish to claim that the intracranial complications are preventable, I do maintain that the chain can be broken, and is best broken at its weakest point. This is the treatment of the naso-pharynx, and if this point is past, and if in a specific case we are in the presence of a florid otitis, we can break the chain at its second link as easily by free paracentesis as free drainage.

The latter process is immeasurably assisted by aspiration of the tympanic cavity as well as physiological. The factors are mechanical, as the first effect of suction is to cause free bleeding from the mucosa of the middle ear, thinning the inflammatory exudate and thus facilitating its removal by gravity, syringing, or aspiration. Local depletion is a secondary result and this, as is well known, has a most favorable effect on pain and inflammation, especially where, as in these cases, the pain is due to tension and pressure.

It is still an open question whether fresh serum has a marked bactericidal action, but there can be no doubt that it is much less septic than the fluid in the inflamed middle ear, so that dilution with fresh blood can be only beneficial. The effect of aspiration on the cut in the drum is to cause it to gape widely or to open if occluded by blood clot. This is an obvious advantage and one of practical value.

No special apparatus is needed. The method is ready at any moment. Any glass bulb will answer which will plug the meatus, does not have a sharp tip to cause possible injury, is wide enough to be easily cleansed out, and will stand boiling. Its diagnostic use enables us to get a large amount of fluid matter from the middle ear which is received directly into a sterile receptacle, without contamination, giving ideal matter for bacteriologic examination, blood count, or Widal's test, which may be of great importance for a differential diagnosis in otitic complications or suspected general disease. It has suggested itself that the suction acts very much like a leech-bite or wet-cup, abstracting blood, and tiring out the walls of the small vessels by continued negative atmospheric pressure (aspiration) and so producing a depletion in the congested area together with a reactive hyperemia at the site of the hypothetic leech-bite, i. e., the incision, and the mucosa of the middle ear. I believe this is a very much more exact way of using the principle of local blood abstraction than by putting a leech on the tragus or the mastoid. It seems to me to be in line with the method of congestive hyperemia of Bier, besides being free from a number of objectionable features connected with the application of a constricting bandage around the neck which has to remain for 24 hours or more, and is very irksome if not intolerable. The degree of hyperemia whether red or blue has to be carefully watched and the technique has to be learned by experience.

While drainage can be assisted it can also be opposed and any methods which interfere with it can not be too strongly condemned. Among them I will mention plugging the external canal with a so-called drain, putting ice bags on the ear or mastoid, producing hyperemia in the middle ear by any method, and finally, Politzerizing or catheterizing in an attempt to blow secretion out through the drum opening. The danger is obvious and real, and no theoretic considerations should tempt us to overlook it. It has been claimed that the mucosa of the aditus is so swollen that it blocks off the antrum from the middle ear so that pus and germs could not be blown into the accessory cavities of the middle ear. I need hardly lay stress on the visionary quality of this theoretic safeguard. We know that in many cases, in spite of this protection, germs or pus do get into the mastoid cells, even where there have been no mechanical procedures tending to drive them there, so that we would naturally avoid any procedure which would have this effect.

XLIII.

THE MORPHOLOGY AND EMBRYOLOGY OF THE NASAL FOSSAE OF VERTEBRATES.

By Leon Dieulafé,

Translated by Hanau W. Loeb.

(Continued from the June Annals.)

BIRDS.

Numerous works on the development of the olfactory apparatus of birds have been published, but they deal with the chicken for the most part.

Historical.—Koelliker (1860) observed the appearance of the olfactory fossettes in the anterior and lateral portion of the cranium of a chicken, at the end of the third day of incubation. They are situated below the eyes. On the fourth day, they are larger and deeper. A groove is formed, the nasal groove, which, elongating the supramaxillary bud, connects the fossette with the buccal cavity. The evaginations forming the olfactory bulbs are added to mucous portion formed by the ectodermic depression.

The two nasal grooves are shortened by the fusion of the superior maxillary and frontal buds. The fossette is limited throughout its periphery, and the nasal groove is transformed into a canal which ends in the buccal cavity by forming the internal nasal furrow (primitive palatine cleft of Dursy). The formation of the palate is concerned in the formation of the respiratory portion of the nasal cavity, the most elevated portion of the primitive buccal cavity. The boundaries of the olfactory organ, the frontal bud and the external nasal buds contribute in the formation of the face at the level of the anterior extremity of the cranium, particularly the ethmoidal and nasal portions.

Parker (1869), who studied the development of the cranium in Gallus domesticus, occupied himself at length with the evolution of the olfactory cavity. At the fourth day of incubation, the nasal cavity is still a simple slit; the nasal cavity is limited by expansions of the trabeculae which constitute its aliethmoidal and alispetal portions; it is a formation continuous with the primordial cranium as the auditory capsule.

On the fifth and seventh day, the canal may be seen uniting the buccal cavity with the nasal labyrinth, between the palate bone and the prefrontal lamina.

Föster and Balfour (1877) found depressions of the epiblast during the third day in the chicken. The olfactory fossettes originate in the same way as the crystaline lens and the labyrinth of the ear, but with this difference, that they are never closed.

Milnes Marshall (1879) finds that the first stages of development in the chicken are analogous to those of the selachians; the olfactory fossette appears at the 54-hour stage in the form of a thickening of the epiblast. With Dohrn, he admits the resemblance of this outline to a branchial cleft, i. e., the first cleft.

Born (1879) gives a lengthy description which coincides with the principal points of that of Koelliker. Fusion of the superior maxillary and external nasal buds are effected as in reptiles. The external nasal bud has a round prolongation, which is the outline of the primitive nasal or middle turbinal. This appears before the separation of the external opening of the choana, which is effected at the end of the fifth day. A protuberance, which is the first manifestation of the beak, lies in the median portion of the face, between the swollen borders of the nasal canal. After the fusion of the different buds, the elevation of the borders of the nasal cavity appears and at the same time the beak gains in length; in this way is constituted the entrance of the canal or vestibule. The entire lateral wall presents a hemispherical swelling which indicates the vestibular turbinal.

At the eighth day of incubation, the nasal gland appears in the form of a solid invagination of epithelium of the internal wall of the vestibule. This gland can not be homologized with the organ of Jacobson, which, on the other hand, must be entirely deficient.

Mathias Duval (1889), in his atlas of embryology of the chicken, indicates the appearance of the olfactory outline as an ectodermic thickening at the 52nd hour of incubation.

Putelli (1888) observes that, at the level of the ectodermic thickening which forms the olfactory outline of the chicken, the cells which are flattened on the borders of this zone become elevated in measure as they advance towards the center. When the olfactory groove is well formed, the larger portion of the wall is covered with high cylindrical cells. Then when the olfactory cavity grows, there are distinguished on its walls an olfactory zone in which the epithelium is very elevated, and a respiratory zone in which the cells are cubical.

A new form of cells appears in embryos six or seven days old; these recall those which Kaufmann and Lustig describe as transitional forms; they are scattered among the high cylindrical cells.

At the seventh to the eighth day, the cylindrical cells have a finely granular protoplasm, which is more slightly colored by carmine than is the nucleus. The cell is prolonged by an extremity more or less conical towards the mesodermic layer, without having the long filiform extremity with which these same cells are provided in the adult mucosa. The transitional forms are colored more intensely; they are situated as sunken rods between the cylindrical cells.

Preobraschensky (1892) gives us another histogenetic study. At the beginning, the olfactory organ of the chicken has a single layer of cylindrical cells; when the primitive olfactory fossette enlarges, the bottom is covered with an elevated epithelium, but the ventral region, which utilizes for its extension the growing neighboring zones of ectoderm, presents an epithelial investment exactly similar to the ectoderm. This is the respiratory region. A thickening, which is the beginning of a large ganglion, is seen anterior to the anterior cerebral vesicle, in an embryo of five days and three hours.

The two regions, olfactory and respiratory, are entirely different; in the respiratory region there are two cellular layers, of which the deep is cubical and the superficial is flat. The filaments of the olfactory nerve may be seen. The lateral wall already shows the turbinals, and the superior turbinal alone appertains to the olfactory region.

On the eighth day, the relation of the olfactory nerve to the olfactory epithelium is very clear and the nervous network is quite visible.

Ganin (1890) considers as the organ of Jacobson in birds an embryonal outline which in reality corresponds to the canal of the lateral nasal gland.

Peter (1902-3) reviews the works of Koelliker and Born and draws conclusions from publications which treat incidentally of the nasal organs. For example, Van Wijhe indicates the first outline in the embryo of a duck having 23 primordial segments, and Abraham in a specimen of Melopsittacus undulatus provided with 25 to 26 segments.

Franz Cohn (1902) studied the development of the olfactory organ in the chicken. It appears at the stage of 23 to 24 primordial segments at the 72nd hour of incubation; it is a flat lamina formed by thick epithelium without any trace of depression. It is first placed laterally on the head and is then more and more displaced towards the ventral surface. The increase of the olfactory groove is effected by active proliferation of the sensory epithelium and not by passive displacement.

In embryos, with a head 5.6 mm. long, the median wall of the olfactory fossa close to the external orifice shows a depression covered with sensory epithelium which corresponds to the organ of Jacobson, but which is of very short duration.

Two turbinals, the one primary or middle, the other secondary or superior, are formed in the region of the nasal cavity covered by sensory epithelium. The vestibular turbinal has its origin in the vestibule, from the wall covered with indifferent epithelium. Cohn, basing his observations on the investigations of Peter, which we shall report later, considers the superior turbinal of birds as homologous with the nasoturbinal of mammals and not the ethmo-turbinal.

Beecker (1902) has observed in Anas domestica and Gallus domesticus that the nasal canal is divided into a vestibule and a turbinal region. The vestibule is very long and narrowed by a dorsal fold, the vestibular turbinal. The choanal canal is not greatly bent. The middle turbinal is homologous with the true turbinal of reptiles. There is no outline of the organ of Jacobson.

Description of Stages. Undulated Parrot. 5 *mm. total length* (5th day of incubation; Fig. 40).—The embryo of this stage, seen in profile with the aid of a binocular microscope, shows the olfactory vesicle under the form of an ectodermic depression largely opened externally and prolonged downward by a groove. This groove is placed below and in front of the eye upon the lateral surface of the head. In transverse sections, the outline is placed at the union of the lateral with the ventral surfaces; it is constituted by a thickening of the ectoderm, which buds and forms a cellular cord, 30 mikra long, separated from the external layer. For a distance of 225 mikra, the ectodermic thickening is depressed into a groove, which has a maximum depth of 71 mikra and a transverse extent of 142 mikra (Fig. 40).

The olfactory zone behind the groove is a simple thickening of the ectoderm; the total length of the outline is 365 mikra. Its width at the level of the groove is 263 mikra, and in the posterior region, where the thickening is not depressed, 285 mikra.

The cells which constitute the olfactory outline are round, separated from one another, and arranged in several layers without forming regular coats. The surrounding ectoderm comprises two layers of small round cells. At the stages of 5.2 mm., 5.5 mm., and 6 mm., there is no change in relations or form, except that the depth of the fossette is increased.

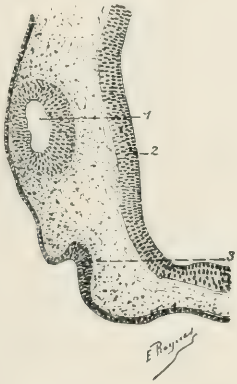

Fig. 40—X 40. Parrot, 5 mm. in total length (fifth day of incubation; transverse section, right side). 1. Eye; 2. Central nervous system; 3. Olfactory outline.

6.5 *Millimeters.*—The mesoderm which surrounds the groove is thickened and forms two buds, which approach one another and fuse at a certain place; this is the zone in which the vesicle is closed in the sections. The thickness of the wall of the olfactory cavity increases from the border towards the bottom.

8.5 *Millimeters.*—Of the two buds, the internal is quite long vertically and the zone of union with the external bud is more extended. The olfactory vesicle changes in form, the external wall is convex and the internal wall is concave. The two cavities approach one another but remain separated by a large zone of mesenchyme, which is to form the nasal septum.

Behind the zone of fusion of the two buds, the cavity opens downwards. There exists, below the septum and between the internal buds, a large space which receives the opening of the two nasal cavities and which is lost below in the buccal space.

The cells which border the fossette begin to assume an elongated form.

9 *Millimeters* (7th day).—The olfactory cavity is a deep depression directed from the ventral surface of the ectoderm towards the infero-external angle of the neural tube. Its bottom is dilated into a vesicle, its ventral segment is narrow and forms a canal of entrance. The epithelium of the canalicular region is composed of large round cells; in the vesicular region it thickens gradually towards the bottom and presents a superficial layer of very long cylindrical cells, of which the large central extremity has a depressed border, while the peripheral extremity sinks between the deep layers of round cells. The buds which limit laterally the narrow region of the cavity are fused posteriorly and form thus a floor which closes the cavity.

11 *Millimeters* (8th day).—The external wall of the olfactory vesicle is no longer simply convex; it presents a large, round, pedunculated ridge directed internally and inferiorly. The nasal lumen sends out a sort of fissure which separates this ridge from the external wall, making a turbinal. The epithelium which covers it is thin below; the external, superior and internal walls have a very thick investment.

21 *Millimeters* (10th day).—The nasal cavity proper is preceded by a region occupied by an epithelial mass, in which the lumen is entirely absent; this is the vestibular region which has a length of 380 mikra.

In the anterior region of the cavity, the superior wall is the site of a voluminous ridge which sinks into the lumen and gives to it, in frontal section, the form of a "U" opened above. In going from before backwards, the base of this ridge is seen contracted, becoming a true pedicle, which is displaced towards the external surface, its line of insertion being oblique from before backwards and from above downwards.

This is the middle turbinal, which has taken on a great extension. Its insertion is 250 mikra on the superior wall and 280 on the external. Its pedicle has a thickness of 185 mikra anteriorly and of 92 towards the middle portion.

The cavity enlarges vertically from before backwards, and at a distance of 650 mikra from the anterior extremity of the vestibular region it opens below into the buccal cavity. The choana, which has a width of 38 mikra, and a length of 240, does not end directly in the buccal cavity. It is joined with that of the opposite side in a canal limited by the palatal buds, with an average width of 71 mikra and a height of 357.

The olfactory epithelium exists only in the posterior portion of the cavity and does not cover the turbinals. A cartilaginous lamina, quite thick, lies all around the nasal cavity, especially at the level of the external wall, the roof and the septum.

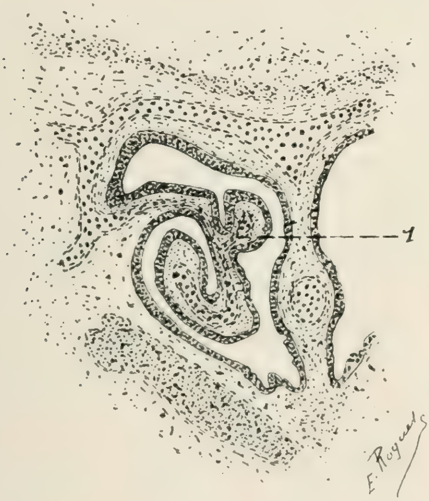

Fig. 41—X 34.3. Parrot, 23 mm. long (17th day of incubation; transverse section, right side). 1. Middle turbinal showing two coiled laminae.

23 *Millimeters* (17th day; Fig. 41 and 42).—The middle turbinal at the level of its insertion on the roof of the cavity has a smaller pedicle than in its preceding stage (100 mikra); its insertion has the same obliquity from before backwards and from above downward. It has two laminated coils, one on each side of the pedicle; the one directed at first internally becomes

superior a little farther along; the other is external, then inferior. Anteriorly the extent of each lamina, measured at the point of departure of the axis from the pedicle, is 357 mikra. The inferior lamina is larger than the superior at the level of the insertion of the turbinal on the external wall; towards the middle portion the inferior is 335 mikra high, while the superior (Fig. 41) is 264. A cartilaginous lamina penetrates into the turbinal and bifurcates at the apex of the pedicle in order to follow each coil (Fig. 41). The inferior lamina is single (Fig. 42) towards the posterior extremity of the turbinal. Behind the middle turbinal and its pedicle, the external wall is the site of another ridge slightly extended antero-posteriorly with a height of 250 mikra in its middle portion, while anteriorly and posteriorly it is only a simple bulging of the wall (Fig. 42).

It is covered with thick epithelium, having the characteristic of that which covers the superior region of the nasal cavity, i. e., of a sensory nature; it forms the superior turbinal.

The floor of the nasal cavity, almost at the level of the union of its anterior with the middle third, sends out a small diverticulum to the interior of the septum, directed downward and inward; its antero-posterior extent is slight; it is a diverticulum in the form of a groove, which represents perhaps a rudimentary organ of Jacobson. We have found no other trace of this organ.

DUCK. *4th day of incubation.*—The olfactory outline, as in the parrot, is represented by a thickening of the ectoderm, which is depressed into a fossette, and which is formed of round cells without differentiation from those of the superficial layer.

7th day.—The fossette is increased, is deeper and is opened directly downward. The thickness of the epithelium increases from the border of the groove towards the bottom, where it is formed of three of four layers of round cells.

10th day.—The anterior portion of the nasal organ is formed by a compact cellular mass which borders a depressed epithelial tract. The lumen which begins to appear is triangular in transverse section, with an apex inferior and two other angles in the form of deep fissures, one of which is directed externally and upward, the other vertically upward. A bud, which is the anterior extremity of the middle turbinal, is found between these two fissures. This turbinal is inserted obliquely from before backwards and from above downwards. It has only one coil directed downward. One millimeter from its anterior extremity, the floor of the nasal cavity is united with the buccal epithelium by a vertical tract, behind which is the choanal fissure. The choana is a large cleft of 414 mikra, which ends directly in the buccal cavity. In measure as the insertion of the middle turbinal descends on the lateral wall the superior

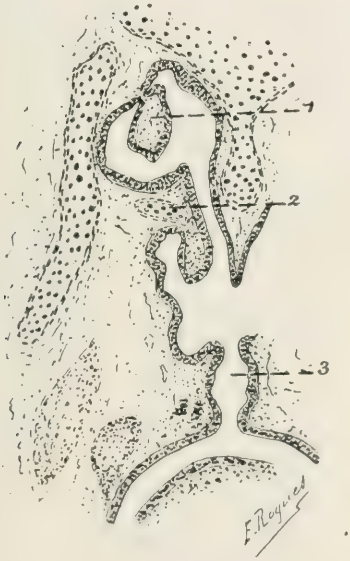

Fig. 42—X 34.3. Parrot, 23 mm. long (transverse section posterior to that of fig. 41, showing the middle turbinal, the superior turbinal and the palatal fissure common to the two nasal cavities, right side). 1. Superior turbinal; 2. Middle turbinal, having at this place only one coil; 3. Palatal fissure.

portion is enlarged. It forms a nasal roof, which is covered with sensory epithelium like the adjacent portions of the external and internal walls. In this region of the nasal cavities there is developed another turbinal placed above the middle turbinal (Fig. 43), a long ridge of 700 mikra. It is slightly internal wall. This turbinal is covered with sensory epithelium in its entire extent. The cartilaginous skeleton lies at the

level of the septum and of the external and superior walls; it sends out a cartilaginous axis to the middle turbinal and is corrugated at the level of the base of the superior turbinal.
elevated anteriorly and posteriorly, having a height of 392 mikra in its middle portion; posteriorly the pedicle disappears

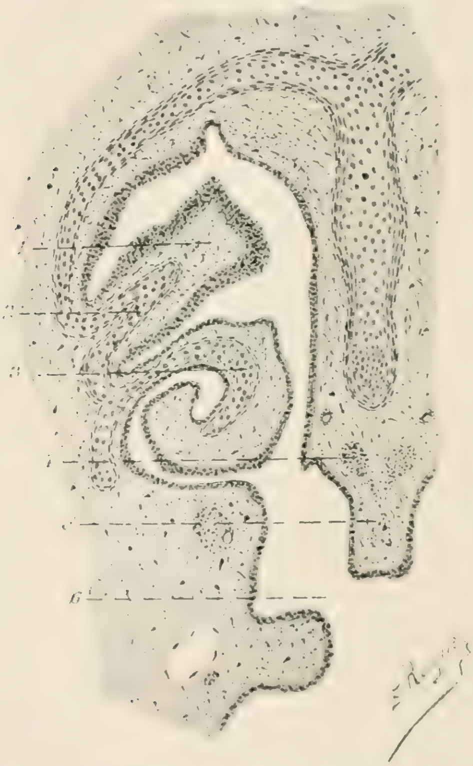

Fig. 43—X 34.3. Duck at 12th day of incubation (transverse section, right side). 1. Superior turbinal; 2. Fold of cartilaginous wall penetrating the superior turbinal in place of a cartilaginous axis; 3. Cartilaginous axis of middle turbinal; 4. Vestige of the organ of Jacobson; 5. Septum; 6. Choana.

and the base of insertion occupies the entire height of the

12*th day* (Fig. 43).—The general arrangement of the cavity is similar to that of the preceding stage; the turbinals are more developed, but occupy the same respective positions. The choanal clefts on each side of the septum attain a common junction in communication with the buccal cavity (Fig. 43). The anterior portion of the nasal cavity is enlarged transversely by a hollowing out of the epithelial mass, which in common with the epithelium of the lateral wall is formed of round cells. In measure as we approach the zone in which the lumen penetrates into this mass, we see the cells of the center becoming larger and clearer, the nucleus smaller and the protoplasm losing its granular character. The resorption of these cells gives rise to the nasal lumen.

The manner in which the cartilaginous skeleton is arranged at the level of the turbinal is interesting. While the middle turbinal is penetrated by a cartilaginous lamina, which forms the axis of the ridge by being located in the center of the mesenchyme, the cartilaginous lamina of the external wall in the interior of the superior turbinal is depressed, forming a fold (Fig. 43). Two dense cellular masses, composed of small, round, sunken cells, lie towards the inferior extremity of the septum. They are placed one on each side of the median line, below the free border of the septum (Fig. 43), and they thus occupy the position of the organ of Jacobson of Mammalia, but there is no other fact which would justify us to accord to it this value.

BEGINNING OF THE OLFACTORY OUTLINE.—According to our investigations on the undulated parrot (Mellopsittacus undulatus) and the common duck, the olfactory outline is a thickening of the ectoderm, which is depressed into a fossette in its central portion. The ectoderm in the undulated parrot of 5 mm. (5th day of incubation) is composed of two layers of round cells. All the cells at the level of the olfactory thickening, which we have observed at this stage, have this form. The most superficial cells acquire a cylindrical form in the bottom of the olfactory fossette, in the 9 mm. stage (7th day of incubation).

Putelli (1888) observed these cylindrical cells from the beginning of the formation of the olfactory fossette. It is true that he does not indicate the exact stage in which these observations begin. Preobraschensky (1876) also finds the differentiation of the cylindrical cells effected at the beginning of the olfactory thickening.

Born (1879) states that in the chicken the olfactory depression, which appears on the 3rd day, is covered with sensory epithelium, which is continuous on its borders with the epidermis, which has two layers.

Cohn (1902) shows the active part taken by the cells of the olfactory thickening in increasing the olfactory fossette, in opposition to the passive role which this region enjoys in its increase, according to Born, Minot, Goette and Preobraschensky. He found the olfactory field placed at first on the lateral walls of the head, then more and more displaced to the ventral region, and finally entirely ventral, even before the depression of the olfactory fossette acquires an appreciable extension.

Koelliker, Born and Cohn indicate the 72nd hour as the beginning in the chicken; that is to say, the end of the 3rd day of incubation. This is, according to Cohn, the stage of 23 to 24 primordial segments.

Mathias Duval represents the olfactory thickening in a chicken embryo of 52 hours, and Keibel in an embryo of 48 hours. Van Wijhe finds the first beginning in a duck with 23 primordial segments and Abraham in the undulated parrot with 25 to 26 segments. We found it in the duck in the course of the fourth day and in the undulated parrot of 5 mm. (fifth day of incubation).

EVOLUTION OF THE NASAL CAVITY.—Koelliker (1860) has well shown how the masses which limit laterally the nasal fossette by fusion limit the external nasal orifice and separate it from the internal nasal orifice, which is the opening in the buccal cavity of the nasal groove transformed into a closed canal.

Born (1879) establishes the appearance of the outline of the middle turbinal on the lateral wall (external nasal bud) before the supervention of the separation of the external opening and the choana. This separation is effected towards the end of the fifth day in the chicken by fusion of the inferior extremity of the external nasal bud with the superior extremity of the superior maxillary bud and with the internal nasal bud. This zone of fusion forms the roof of the nasal cavity, where it appears in the form of a closed vesicle, in frontal sections.

Behind the bridge thus formed, the nasal cavity communicates with the buccal cavity by a cleft situated in a horizontal plane; this is the choana, which definitely preserves this disposition. Born has found the palatal lamina arising from the superior maxillary buds, but they are not united with one another and the palate remains cleft. We see between the maxillary buds a space which communicates above with the two nasal cavities, in which the free extremity of the septum makes a ridge, and which, on the other hand, opens largely into the buccal cavity.

Anteriorly, the nasal and maxillary buds enter into the constitution of the face; however, they take on an elongated form, the length of which varies infinitely, depending on the species of the bird, the buds increasing antero-posteriorly.

The nasal cavity increases between them in the same direction, and thus an anterior vestibular region is formed. The buds being greatly separated from one another, there is no cavity at the beginning of the formation of the vestibule and the external and internal epithelial walls are in contact.

Most of the time, the external wall is strongly convex and presents the outline of a ridge which is to become the vestibular turbinal.

This region forms the epithelial pad in which the vestibular lumen is secondarily hollowed. The formation of the vestibule carries the displacement anterior to the external orifice.

The nasal cavity and the vestibule are complicated by the formation of the turbinals. The first turbinal appears disposed as that of the reptiles; it takes its origin anteriorly on the superior wall or the most elevated portion of the external wall, and its line of insertion is directed obliquely downward and backward in such a manner as to acquire a lower and lower position on the external wall.

The posterior region of the cavity contains another turbinal, the superior, arising from the external wall above the insertion of the middle turbinal. Only the superior turbinal is developed in the region covered by sensory epithelium; it has an investment of this sort. The middle turbinal is distinctly placed in the respiratory region towards the anterior extremity, where it appertains, so to speak, to the nasal roof. The olfactory epithelium does not exist at its level.

Born and Cohn consider that the two turbinals originate in the olfactory region. As to the vestibular turbinal, it is a formation belonging to a zone covered with an indifferent epithelium, as Born and Cohn established before us. The process of fissuration, the importance of which we have noted in reptiles, enjoys here a role of the same value.

We see the narrow diverticula of the nasal lumen sinking into the thickness of the walls, thereby depressing the epithelium. A ridge is circumscribed between two fissures of this kind, enclosing a mass of mesenchyme, whose increase has an active role in the development of the turbinal.

When the turbinal rolls up, one of these fissures continues, penetrates into the mass of mesenchyme, cuts it more or less and detaches a part which has a twisted appearance.

The double coil of the middle turbinal in the parrot is remarkable; in this case the two bordering fissures have a symmetrical evolution and hollowness of the two lamina results. This arrangement is found only in certain mammals (ruminants, pachyderms). The arrangement of the cartilaginous skeleton in the interior of the turbinal is therefore of some interest; the middle turbinal has an axial lamella, arising from the external cartilaginous wall, which penetrates into the mesenchyme at the free border of the ridge, presenting a parallel coil.

The cartilaginous lamina, which penetrates into the superior turbinal, is formed by a fold of cartilage of the external wall; there is no pedunculated portion. From the fact that this turbinal has no pedicle, it is not a true turbinal, according to Gegenbaur, but a pseudo-choncha, like that of the crocodile.

The middle turbinal, according to Gegenbaur (1873), corresponds to the maxillo-turbinal or inferior turbinal of mammals.

This comparison rests especially on the position of the orifice of the lachrymal canal below the middle turbinal of birds as below the inferior turbinal of mammals. The vestibular turbinal being a formation peculiar to birds, not present in all species, there is no place to look for its homologue.

The superior turbinal has been compared to the ethmo-turbinal of mammals. This is not the opinion of Peter, who shows that the ethmo-turbinal is formed by fissuration of the median nasal wall, while the naso-turbinal and the maxillo-turbinal belong to the external wall. Cohn has clearly observed in the chicken that the superior turbinal is a formation of the external wall, and is homologized with the naso-turbinal and not the ethmo-turbinal.

According to our investigations on the parrot and duck, the superior turbinal is formed in the posterior extremity of the nasal cavity, and besides is covered with olfactory epithelium.

It should therefore correspond to the olfactory turbinal or ethmo-turbinal.

With reference to the absence of the organ of Jacobson, we gave, in the Chapter on Morphology, the opinions of Ganin and Mihalkovics, who admit its existence in a rudimentary state. Cohn noted a depression covered with sensory epithelium on the median wall of the olfactory fossette of the embryo of a chicken, with a head 5.6 mm. in length. The cells of this epithelium are cylindrical with a basal nucleus and are twice as high as those of the indifferent epithelium. This depression which is found in embryos, with a head-length of 5.9 mm., is not observed in the succeeding stages.

We found, in the parrot of 23 mm. (17th day), and in the duck of twelve days, some formations which might represent the vestiges of an organ of Jacobson. We observed a diverticulum of the nasal floor sinking into the septum in the parrot, and a cord of round cells in the duck placed below the septal cartilage.

Admitting, as we have, that the palatal fissure permits the olfactory epithelium to have the function of sensory control of the buccal contents, we explain the absence of the organ of Jacobson in the adults, but it is difficult to affirm that it produces no anlage, being rudimentary itself.

Born and Cohn noted an evagination of the lumen, between the middle and superior turbinals, which was directed backward, forming the beginning of the sinus orbitalis.

Born found, on the eighth day of incubation, the beginning of the lateral nasal gland constituted by a solid epithelial evagination of the vestibular wall, close to its posterior extremity. The glandular canals are provided with a lumen on the fourteenth day.

MAMMALS.

HISTORICAL. *I. Nasal Cavity.*—Meckel (1812) considered the buccal and nasal cavities as originally forming only one spacious cavity, which later is separated into two distinct compartments. This view had many partisans, among whom the embryologists Caste and Erdl may be cited. It survived a long time, in spite of the investigations of Von Baer, Rathke, Huschke, Reichert, Bischoff and Remak, who observed that from the beginning there existed two perfectly separated cavities. Von Baer named them the olfactory fossettes.

Rathke was the first to observe these fossettes in mammals, Bischoff, in the dog.

Koelliker (1882) described them in man and found them first in an embryo of four weeks. This author studied their formation in the rabbit; they are preceded by a considerable thickening of the ectoderm. In the continuation of the evolution, he describes the closure of the nasal fossa by coalescence of the nasal and superior maxillary buds, as in the chicken. The formation of the palate subdivides the buccal cavity into two portions: the superior or respiratory, which is the nasopharyngeal canal, and the inferior or digestive, which is the real buccal cavity.

Dursy (1869) observed the olfactory fossette forming in the human embryo on the lateral wall of the head in front of the eye. The border is increased by a cushion, which greatly deepens the fossette. A depression on the internal wall forms the organ of Jacobson.

The external and internal nasal buds, as well as the superior maxillary bud, limit the fossette and fuse together, closing it below. Behind this zone of union a cleft is seen, the primitive palatal cleft.

The evolution of the different buds of the face and the formation of the palate were extensively studied by this writer.

His gives the name of nasal field to the ectodermic thickening which forms in front of the olfactory depression. His reconstructions of the human embryo show with great distinctness the fusion of the nasal and maxillary buds and the formation of the palatal vault.

Rémy (1878) showed the ectodermic origin of the pituitary membrane; he insists especially on the histogenesis of this mucosa and the differentiation of the epithedial cells. The glands appear in a human embryo 18 cm. in length. The turbinals are well developed at this stage. The maxillary sinuses appear towards the fourth month of fetal life, a little before the ethmoidal sinuses are formed. The sphenoid sinus appears towards the end of the first year after birth, and the frontal sinus from the seventh to the eighth year.

Hertwig describes the formation of the external and internal nasal orifices, the palatal vault, the turbinals and the sinuses, according to the His casts and sections of the embroyo of a pig.

Legal (1883) follows the evolution of the nasal cavity and the organ of Jacobson in embryos of the pig. He is concerned more especially with the formation of the turbinals. An epithelial bud lies external to the inferior primitive nasal canal; it indicates the separation between the superior maxillary and external nasal buds and forms the lower boundary of a convex swelling of the external nasal wall, which is the beginning of the inferior or primary turbinal.

Another elevation which is separated from this by a groove is the beginning of the secondary olfactory turbinal.

Laguesse (1885), in a thesis on the development of the respiratory epithelium, follows the evolution of the ectodermic cells which cover the nasal fossae. In a sheep embryo of 1.7 cm. (in a straight line), about five weeks old, the epithelium of the olfactory cavities had not lost its embryonic characteristics. Its thickness, quite uniform, is about 45 mikra; it is formed of small, finely granular cells, staining uniformly. There can already be seen some sparse, spherical or polyhedral, vesicular cells with a membrane of distinct thickness, a clearer, slightly granular cell-body and a round nucleus. In embryos of 5 cm., the epithelium is slightly increased in thickness, but the majority of the cells are subjected to a transformation, which consists in an augmentation of the transparency of the cell-body. The process is generalized throughout the height of the epithelium. The cells are disposed irregularly in three layers; it is an embryonic stratified epithelium in process of evolution towards the cylindrical stratified form. The nucleus is double in size. In the 6 cm. stage (second half of the second month) the phenomenon of the formation of the clear cells is regulated; they are not distributed at hazard, but a deep, dark, genetic layer and a superficial layer with clear cells are found. These cylindrical or polygonal cells have a transparent center with a few granules arranged upon the border.

Some cells in the inferior meatus have numerous slender, short cilia, about 4 mikra in height. In the superior portion of the nasal fossae, the thickness of the epithelium reaches 70 mikra and the cells are longer.

The epithelial plug of the nares made it possible for Laguesse to study the cellular transformations. In embryos of 10.5 to 11 cm. the cylindrical cells are longer; in a large number of cases they are provided with a group of fine cilia, implanted on an expanded projecting surface.

According to Laguesse, the embryonic form passes into the ciliated cylindrical cell by gradual substitution of two sorts of elements.

The epithelium of the olfactory portion, which is thicker, is not subjected to mucous transformation, but remains granular in its entire thickness. Two kinds of elements, described by Max Schultze, are found in embryos of 10 and 15 cm.

The maxillary sinus already exists in an embroyo of 3.5 cm., and is represented by a hollow epithelial involution; in the six centimeter stage, it has the form of a long tube; its cavity is greatly extended in a 13 cm. embryo. At this stage, the epithelium comprises a large number of ciliated cylindrical cells in the midst of mucous cells.

Glands appear in the embryo of 13.5 cm. in the anterior portion of the nasal fossae; they are preceded by a solid epithelial bud.

Hochstetter (1891) gives his personal observations on the formation of the choanae in the cat and rabbit. He is not in accord with the writers in what concerns the formation of the primitive palate. The superior maxillary bud is not concerned in the boundary of the external nasal orifice. The external and internal nasal buds, in fusing, limit the nasal cavity and transform it behind into a cul-de-sac, while it is largely opened anteriorly. An epithelial lamella unites the epithelium of the nasal cavity with that of the buccal roof.

The mesodermic masses fuse and form the primitive palate, after rupture of the epithelial lamina. In the posterior portion, there is only a thin epithelial lamella between the two cavities, the bucco-nasal membrane. This membrane is broken up, establishing an orifice which corresponds to the nasal canal or primitive choana of the writers; at least, the union between the nasal and buccal cavities is secondary in the cat and rabbit. In 1892 Hochstetter found the bucco-nasal membrane in the human embryo, and, as a consequence, the secondary establishment of the choana.

Zuckerkandl (1892) studied the development of the ethmoidal turbinals in man. In the beginning, the ethmoid forms a ridge projecting into the nasal cavity, and the surface, which should hold the turbinals, has a short sagittal groove, which later becomes the ethmoidal fissure.

The surface is thus divided into two olfactory projections, of which the inferior represents the future middle turbinal; in old embryos, the three turbinals represent the typical fissuration of the ethmoid; sometimes the superior is doubled, making the number four.

Keibel (1893) established in human embryos the correctness of Hochstetter's findings.

Mihalkovics divides the nasal cavity into three zones in a human embryo of three and one-half weeks; the middle zone, the most essential, extends throughout the length of the ethmoidal turbinal; the anterior portion corresponds to the nasal vestibule with a beginning portion of the inferior turbinal, and the posterior zone comprises the region of the sphenoidal sinus and of the naso-pharyngeal canal.

The middle turbinal arises anteriorly as an almost vertical lamina from the superior portion of the lateral nasal wall. The inferior turbinal arises at first from the bottom of the nasal cavity and the inferior meatus is a simple cleft. The superior turbinal is constructed in the posterior part of the middle zone by a thick prolongation of the paranasal cartilage covered by mucosa.

The two walls are fused by bridges of mucosa in the posterior zone, forming above a blind recess which is the anlage of the sphenoidal sinus, and below the naso-pharyngeal canal.

Schönemann (1901) concerned himself with the formation and growth of the turbinals. The lateral wall of the nasal lumen is fissured by epithelial bands forming a sort of epithelial diverticulum in the form of clefts. The projecting part of the wall is established between these clefts; in this way the three primitive fields or primitive buds are formed: the maxillo-turbinal, the naso-turbinal and the baso-turbinal. The entire system of clefts is formed internal to the peripheral skeletal wall; all are not concerned in the formation of turbinals, certain ones ending in the formation of accessory cavities.

The lumen of the nasal cavity does not correspond to the external form of the snout, and the simple primitive pouch is enlarged by the cavities and clefts. There are established also accessory clefts, longitudinal on the inferior turbinal, and perpendicular to the base of the cranium on the baso-turbinal The high epithelium at the beginning is localized in the fissures, later on the baso-turbinal. It is disposed in rays parallel to the olfactory branches which form the olfactory projections (rabbit 18 days old). In the cat, three clefts, arising from the lateral ethmoidal fissure, penetrate into the mass of the baso-turbinal, and later this formation of clefts is multiplied.

We may distinguish among the turbinals those which are established on the baso-turbinal from those which appertain to the external wall (comprising the naso-turbinal); according to their situation, we may distinguish the choncha obtecta from the choncha aperta.

The field of the naso-turbinal is very much limited; in man it forms only the agger nasi; it is well developed in the cat, ox and rabbit.

The secondary turbinals, which are established on the naso-turbinal, are not well developed in any group of mammals.

Strasser (1901) studied in the series of vertebrates the role which is occupied by the increase of the mesoderm in the formation of the snout and in the location of the nasal fossae. In reference to the turbinals of mammals, according to the opinion of Schönemann, he does not admit that the turbinals take on a proper extension and can thus compel the nasal cavities to increase; they use the disposable space, but do not create it. The expansion of the nose and of the accessory cavities is the result of the increase of the skeleton which the implantation of teeth, the muscles of mastication and the development of the brain necessitates. He finds a sort of law regulating the disposition of the fissures which cut the turbinals into lamellae.

The layers of the inferior turbinal have a longitudinal direction. They are arranged in the direction of the current of air. The clefts and fissures of the ethmoidal turbinals are directed dorso-ventrally parallel to the ramifications of the olfactory nerve.

Karl Peter (1902) finds, contrary to Hochstetter, that the superior maxillary bud in the rabbit, as well as in man, takes part in the limitation of the olfactory fossette; the external nasal bud enters into the constitution of the primitive palate.

This author, during the same year (1902-1), followed the development of the turbinals and established the homology of these organs in the different groups of the vertebrates. These observations were made on the rabbit and man. As Born established in the sauropsidians, and Schönemann and Legal in the mammals, the formation of the turbinals is due to the separation of parts of the external wall by grooves and not by active growth of the projection. The ventral or maxillo-turbinal projection is thick, the dorsal forms the naso-turbinal. The posterior turbinal, or ethmo-turbinal, originates in a rabbit with a head length of 3.5 mm. from the median wall of the posterior segment of the olfactory fossette. Projections placed in the posterior portion of the lateral nasal wall are distinguished from the ethmo-turbinal. These are the conchae obtectae. Behind the naso-turbinal, the lateral wall sinks into a hemispheric fossa at the level of a convex fold anteriorly and externally; this is the processus uncinatus. The clefts form ventrally the maxillary sinus and dorsally a large groove (recessus posterior superior) which overhang the conchae obtectae.

According to his observations on the rabbit, he separates the turbinals into two groups: those which arise from the external wall (maxillo-turbinal and naso-turbinal), and those which have their origin from the internal wall (ethmo-turbinal).

Beecker (1903) studied Sus domesticus and Ovis aries. He divides the nasal canal into the vestibular, turbinal and cribriform portions; the region of the turbinals is greatly extended in length.

. The naso-turbinal (Rhacis) arises from the lateral wall; the maxillo-turbinal corresponds to the turbinal of reptiles.

The organ of Jacobson opens at the anterior extremity of the choanal canal. The choanae are divided into two segments by the growth of the palatal laminae.

The small anterior portion persists as the incisor canal. The large posterior portion opens into the naso-pharyngeal canal. The cribriform portion is established as a new production by a complicated fold from the antorbital wall, which permits five cribriform pockets to bud laterally. On the internal surface, the olfactory projections are exposed in order to surround the entrance of the pockets.

Fleischmann (1903) remarks that whatever the development which takes place in the nasal cleft, it always remains a narrow cleft and extends only in height and length.

II. Organ of Jacobson.—The first embryologic investigations are those of Balogh on the sheep and Koelliker on man. Dursy (1869) observed the establishment of the organ of Jacobson in a rabbit as an early hemispheric depression, with large dimensions and thick walls. He found this formation in human embryos 8 to 20 cm. long. Later the organ disappears without leaving any traces, although the cartilage which Huschke describes at the anterior and inferior extremity of the cartilaginous septum seems to indicate it. It persists sometimes at this level under the form of a canal opening into the nasal cavity. There are some differences between the organ of Jacobson of the human embryo and that of other mammals; in the human embryo it is a canal which always remains membranous simply, its orifice into the nasal cavity opening into a fossa leading to the canal of Stenson; it is not surrounded by a cartilaginous lamina and it is situated a little above the thick inferior border of the septum. In other mammals, on the contrary, the canals of Jacobson and Stenson are directly fused, the organ is surrounded by a cartilaginous box and lies very low, and its deep surface is placed on the bottom of the nasal cavity.

Rémy (1878) found this organ in the cat, placed as in the adult, at the angle of junction of the medial septum with the floor. Anteriorly it opens into a cleft which forms the communication between the mouth and the nose, and posteriorly it terminates in the midst of glandular acini. In a 2 cm. human embryo, Rémy found a point corresponding to the epithelial tube, but without cartilaginous envelop. In another embryo of 8 cm. only a poorly defined epithelial mass existed at this place.

Klein (1881) finds the relation of the organ of Jacobson analogous to that of the adult in a 4 cm. embryo of the India pig.

Harvey (1882) describes the relations, in the fetus of a cat, of the organ of Jacobson with the canal of Stenson, the septum and the nasal floor.

Roese (1893) notes the organ of Jacobson in a human fetus 18 cm. long, placed in an antero-posterior cul-de-sac 0.7 mm. long, which opens anteriorly into the buccal cavity. It is situated at the inferior extremity of the septum, almost at the bottom of the nasal cavity. The basal cartilage of the nasal septum forms the framework of this organ.

Roese observed the organ of Jacobson in an embryo of the wombat 1.9 cm. long, in the form of a tube 0.5 mm. in length; it opened on the inferior wall into the canal of Stenson, and posteriorly it received a large gland. This gland is only a solid epithelial bud in the embryo of an opossum 15.5 mm. long.

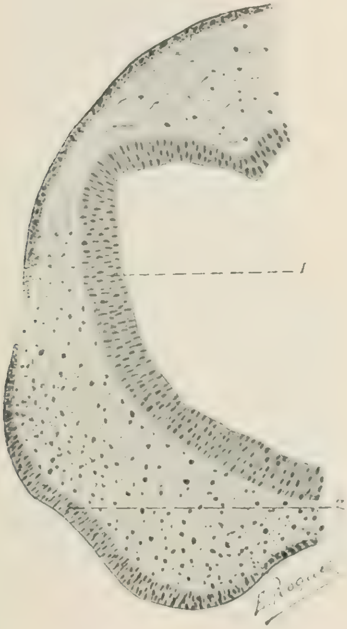

Fig. 44—X 60. Guinea-pig 5 mm. long (transverse section, right side). 1. Nervous system; 2. Olfactory thickening.

Garnault (1895) agrees in what pertains to the rudimentary organ found by Koelliker and does not accept the view of Gegenbaur.

He bases his opinion on the fact that he has met with the organ of Jacobson in the human embryo of 2 or 3 months; on the other hand, he contests the necessity of a connection between this organ and the cartilages of Huschke. These cartilages are supporting organs for the septum and their relations with the tube of Jacobson are purely contiguous and accidental.

Mihalkovics (1899) marks the precocious development of the organ of Jacobson of mammals in the form of an evagination of the epithelium of the nasal cavity in the ventral portion of the internal nasal bud. He finds it thus in the human embryo of three weeks.

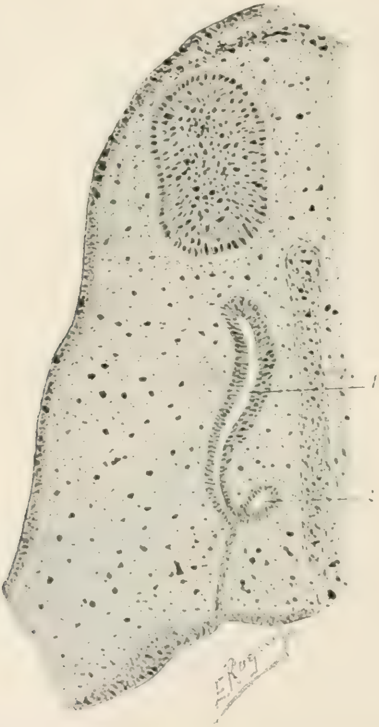

Fig. 45—X 34.3. Guinea-pig 12 mm. long (transverse section, showing the origin of the organ of Jacobson on the internal wall of the cavity, right side). 1. Nasal cavity; 2. Organ of Jacobson.

He does not admit the necessity for relation between the organ of Jacobson and the paraseptal cartilage of Huschke.

Tourneux represents the organ of Jacobson in the human embryo above the inferior border of the septal cartilage.

DESCRIPTION OF STAGES. GUINEA PIG (CAVIA COBAYIA). 5 *mm. total length* (Fig. 44).—The ectoderm is formed of a single layer of flat cells. The central nervous system in transverse sections has the form of a heart with point below. At the angle formed by the junction of the ventral with the lateral surface of the head, the ectoderm is thickened in an elliptical zone, 640 mikra long and 428 wide in its middle portion. It has three layers of round cells in process of division (Fig. 44). The dorsal third of this zone sinks into a fossette and the depression, more and more marked towards the posterior region, has only a very slight depth. It penetrates directly internally into the mesenchyme. The cells of the olfactory thickening are all round.

6 *Millimeters.*—The anterior portion of the nervous system, in transverse sections, is a large vesicle divided into two dilated portions, communicating by a canalicular portion. The ectoderm has only a single layer of cubical cells with a large nucleus. The olfactory region has three or four layers of round cells; it is depressed into a deeper fossette. Two masses of mesenchyme limit it laterally: one internally, the other externally.

12 *Millimeters.*—The olfactory groove is opened below in the anterior region, as in the preceding stages: then the internal and external buds are fused in order to form a floor which constitutes the primitive palate. This floor has a length of 540 mikra; at its level the cavity is closed and elongated vertically (Fig. 45). Near the inferior extremity of the internal wall, a depression extending vertically sinks into the septal mesenchyme. It has the form of a groove for 340 mikra, and behind it is prolonged in the form of a cylindrical canal detached from the nasal wall and isolated in the septum; this is the organ of Jacobson.

The cavity elongates inferiorly behind the primitive palate and communicates with the buccal cavity. As Hochstetter states in the cat and man, a bucco-nasal membrane exists in the guinea pig, formed by a single layer of flat epithelial cells, closing the choanal fissure.

In the region of the choanal clefts, the external wall of the nasal cavity presents two convex projections separated from one another by a short fissure directed externally. The vertical extent of the inferior projection is 378 mikra and that of the superior 192. They represent the naso-turbinal and maxillo-turbinal. The most elevated portions of the nasal cavity (roof and adjacent portions of the internal and external walls) present a thick epithelium of which the superficial cells are cubical or cylindrical.

The canal of Jacobson has a thick epithelial wall, and the most internal layer is formed of very clearly differentiated cylindrical cells.

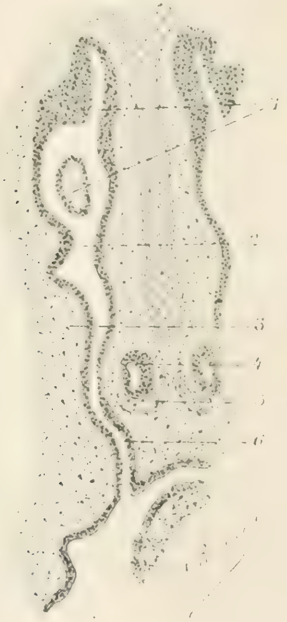

Fig. 46—X 34.3. Guinea-pig 14 mm. long (transverse section, showing fields of origin of the different turbinals, right side). 1. Ethmo-turbinals; 2. Naso-turbinal; 3. Maxillo-turbinal; 4. Organ of Jacobson; 5. Paraseptal cartilage; 6. Choana.

14 *Millimeters.*—The olfactory cavities are displaced transversely, and open on the lateral surface of the head. The entrance of the cavity is occupied by epithelial tissue with large round or polyhedral cells over an anteroposterior extent of 120 mikra. The cavity penetrates into cellular mass under the form of a central lumen. From the anterior extremity of this

lumen, the external wall has a ridge which bounds two fissures, one directed vertically downward, the other, superior, directed externally and upward. This ridge, or inferior turbinal, occupies at its anterior extremity the entire vertical extent of the external wall; this increases in height from before backward, and is divided into two fields by an external fissure, as in the preceding stages. Above this fissure, the external walls presents the ridge of the naso-turbinal (Fig. 46). This turbinal begins 170 mikra back of the anterior extremity of the maxillo-turbinal. It has a length of 840 mikra and the maxillo-turbinal measures 1.1 mm.

The cavity increases transversely behind the naso-turbinal and presents another turbinal at the junction of the external and superior walls. It is freely prolonged anterior to its pedicle into the cavity for a length of 270 mikra; the pedicle is 130 mikra long (Fig. 46). The superior wall at this level has another ridge limited laterally by fissures which rise vertically. These last two ridges are the ethmoidal turbinals. In their entire extent and in the corresponding region of the septum, the epithelium has sensory characteristics.

The organ of Jacobson has the same disposition as in the preceding stage, but its posterior extremity does not reach the choana. A cartilage in the form of a groove, opened externally and superiorly, lodges this organ; it is in relation with the internal and inferior surfaces (Fig. 46); this is the paraseptal cartilage. The choana still has the disposition of a primitive palatal cleft, but the bucco-nasal membrane no longer exists. It is less extensive anteroposteriorly on account of the elongation of the primitive palate. The posterior extremity of the cavity behind the choana is a diverticulum, which fusion of the ethmoidal turbinals with one another and with the internal wall divides into several spaces.

SHEEP (OVIS ARIES) 8 *millimeters.*—The olfactory outline is a thickening of the ectoderm situated on the ventral wall of the head, below the nervous system, slightly depressed into a fossette. The cells of the superficial layer are cubical and clear in the bottom of the fossette.

10 *Millimeters.*—The olfactory fossette is deep and widely open below; the mesodermic masses which limit it internally and externally are fused for a slight extent. Behind this bridge of fusion, the fossette is separated from the nasal cavity

by a thin bucco-nasal membrane. The fossette in its middle portion has a depth of 357 mikra and a width of 107 at the level of its superior third. Its internal wall presents a depression in the form of a longitudinal groove, which is the anlage of the organ of Jacobson. This groove, which is 240 mikra long, begins 105 mikra behind the anterior extremity of the olfactory groove and stops 187 mikra from its posterior extremity; it has a length of 92 mikra and a depth of 42 in the region where it is best marked.

The epithelial layer at the level of this depression and over the whole of the internal wall of the nasal cavity has a thickness of 71 mikra, while it is almost a half less at the level of the external wall. The superficial layer of epithelium in the organ of Jacobson and in the bottom of the olfactory fossette is formed by elongated cells.

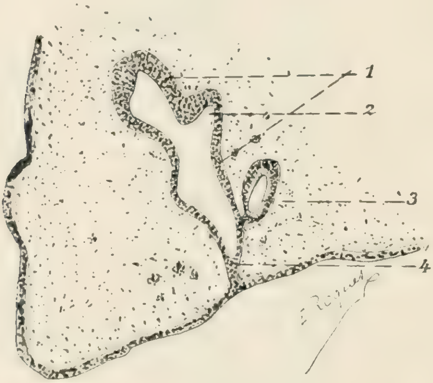

Fig. 47—X 34.3. Sheep of 14 mm. total length (transverse section, showing the internal wall of the nasal cavity divided into two segments, right side). 1. The two segments of the internal nasal wall; 2. Groove showing the summit of the angle of flexion; 3. Organ of Jacobson; 4. Fusion of nasal buds.

11 *Millimeters.*—The olfactory cavity is larger and deeper; the depression of Jacobson is increased. The epithelium which covers this groove is thick, like that which covers the bottom of the fossette, and the cells have a less elongated form.

12 *Millimeters.*—At the level of the organ of Jacobson the superficial epithelial cells may be clearly seen taking a cylindrical form and presenting an excessively clear internal extremity, while the peripheral portion is sunken and contains the nucleus.

14 *Millimeters.* (Fig 47).—The olfactory cavity has acquired a large size; the organ of Jacobson 217 mikra long, is a groove for a tract 150 mikra long, the remainder of its extent having the form of a cylindrical canal isolated from the nasal wall and free in the mesenchyme of the septum. It begins 480 mikra from the anterior extremity of the cavity.

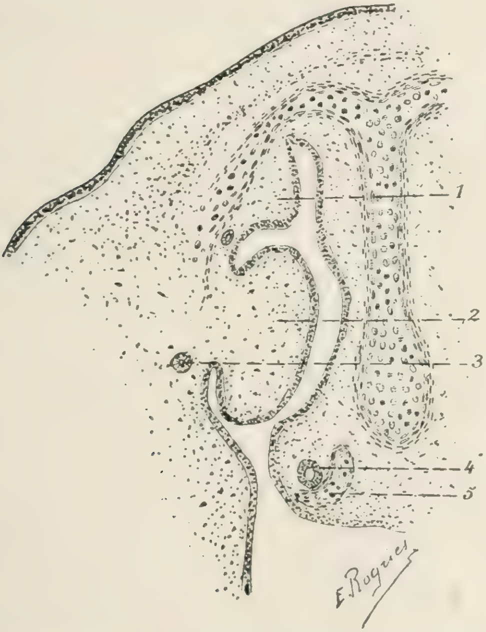

Fig. 48—X 34.3. Sheep 25 mm. long (transverse section, right side). 1. Naso-turbinal; 2. Maxillo-turbinal; 3. Lachrymal canal; 4. Organ of Jacobson; 5. Paraseptal cartilage.

The primitive palate is very extensive, its length being 382 mikra. The olfactory cavity has a height, or depth, of 857 mikra at the level of the anterior extremity of the choana. The bucco-nasal membrane still exists. The internal wall is vertical for an anteroposterior extent of 480 mikra; from this point, it presents a sort of longitudinal furrow which divides it into two segments: one, anterior, which remains vertical, the other, superior, which is oblique from below upwards and from within outwards (Fig. 47). The furrow parallel to the nasal floor is placed 571 mikra above it. The nasal roof does not exist, so to speak, in the anterior portion of the cavity; it is formed by the round bottom of the primitive olfactory groove, but the furrow, after an anteroposterior projection of 97 mikra, becomes deeper and the superior segment of the internal wall is inclined more and more externally.

The epithelium which covers the superior segment of the internal wall and the furrow which limits it below is much thicker than that of the inferior segment of this wall; it has the same characteristics as it has on the nasal roof. The external wall of the cavity presents a convex ridge.

15 *Millimeters.*—The most interesting transformations occur in the superior segment of the internal wall. The furrow which limits it is transformed into a fissure 425 mikra deep, directed superiorly and internally.

The superior portion of the internal wall is now directed transversely and forms the roof of the cavity. This roof is strongly convex inferiorly in its anterior portions, and horizontal in its posterior portion. This region thus displaced will form the largest extent of the ethmoidal field.

25 *Millimeters.* (Figs. 48 and 49).—The external opening of the nasal cavity is situated on the dorso-lateral surface of the head and passes into a cavity in the form of a fissure elongated vertically, but oblique downwards and outwards, the walls of which are convex externally and concave internally.

The convexity of the external wall continues to increase and is very pronounced 240 mikra behind the external nasal orifice; below it fuses with the nasal wall, while above it is separated from it by a fissure directed externally and inferiorly.

It is pedunculated 340 mikra from its anterior extremity and represents clearly a turbinal; this is the maxillary turbinal (Fig. 48), which has the form of a convex process, leaving its pedicle in a symmetrical manner above and below; it has as yet no coiled lamina. The lachrymal canal opens on the nasal wall below this turbinal.

The external wall, above the fissure forming the superior limit of the maxillo-turbinal, has another ridge, less marked and shorter than the first, corresponding to the naso-turbinal (Fig. 48). The cavity is enlarged behind the naso-turbinal in order to lodge the ethmoidal turbinals. One of them arising from the superior portion of the external wall, is pedunculated and voluminous.

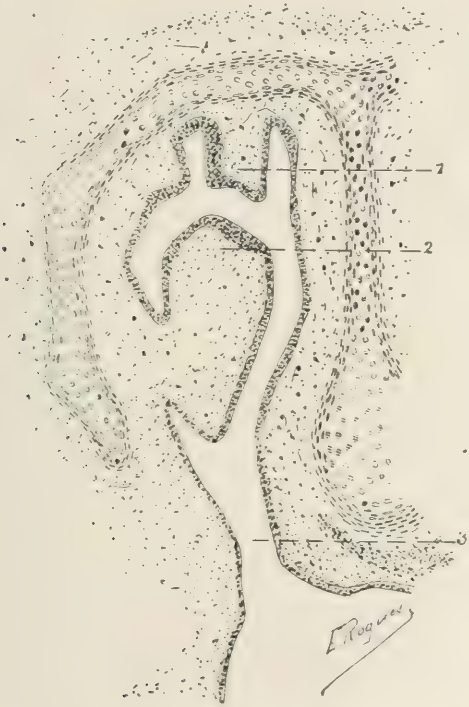

Fig. 49—X 34.3. Sheep 25 mm. long (transverse section, posterior to that shown in Fig. 48, passing through the posterior extremity of the primitive choana). 1 and 2. Ethmo-turbinals; 3. Primitive choana.

Two others, lying on the superior wall, are simple ridges limited by vertical fissures. All the turbinals and the internal wall in its superior portion have a thick epithelial investment with cylindrical cells (Fig. 49).

The organ of Jacobson opens into a furrow only in a small portion; everywhere else it is a cylindrical canal placed towards the inferior border of the septum, below the cartilage of the septum. It is incompletely surrounded by the paraseptal cartilage (Fig. 48). Its total length is 1.26 mm. while the nasal cavity measures 2.86 mm. The organ of Jacobson begins 500 mikra behind the anterior extremity of the nasal cavity. The epithelial wall is very thick, the total diameter of the canal at its most voluminous point being 150 mikra while the lumen is only 28. The epithelium is of a sensory nature over the whole lumen.

The choana is arranged like a palatal cleft. The posterior extremity of the cavity contains only the ethmoidal turbinals, and these by uniting together partition the cavity. This region is entirely covered by sensory epithelium.

The cartilaginous skeleton forms the external, superior and septal walls; it still does not send any cartilaginous axis into the turbinals.

7 *Centimeters.*—The external forms are those of the adult: the snout has reached its complete development. In a sagittal section we see that the external wall carries a maxillo-turbinal analogous to that of the adult. The ethmo-turbinals are formed by a process directed obliquely from above downward and from before backward, parallel to the posterior border of the maxillo-turbinal; its superior portion after bending is directed backward. This process forms thus an incomplete framework in the area of which are disposed four small longitudinal processes, united together by their anterior extremities. There is found along the nasal roof a small process, the middle portion of whose inferior border extends between the maxillo-turbinal and the anterior ethmo-turbinal; this is the naso-turbinal.

The maxillo-turbinal presents in transverse sections two coiled laminae, and we see the naso-turbinal inserted at the superior boundary of the external wall.

CALF. We have examined some calf fetuses of large dimensions. In a subject measuring 2 cm., the turbinals are well developed and the inferior turbinal is divided into two coiled laminae, one superior and the other inferior. The ethmoidal cells and the maxillary sinus are of considerable dimensions.

The sphenoidal sinus in a 14.5 cm. embryo forms a cavity occupying the whole of the body of the sphenoid; this is the most remote portion of the ethmoid region, unoccupied by the turbinals and separated from the nasal cavity.

MOLE (TALPA EUROPOEA). 4 *Millimeters.*—The beginning of the olfactory anlage is an ectodermic thickening placed at the level of the union of the ventral and lateral surfaces of the head. It is a disc 292 mikra long and 428 wide in its middle portion. Its maximum thickness is 42 mikra. It is composed of round cells. The first trace of cellular differentiation is indicated by the fact that for a slight extent of the disc the superficial cells are clear in their external segments, and present a nucleus more removed from the surface than that of the adjoining cells. This shows that the elements are beginning to elongate.

5.5 *Millimeters.*—The olfactory thickening is depressed into a deep fossette, the mesodermic buds which limit this fossette laterally are fused behind to an anteroposterior extent of 90 mikra. The epithelial wall of the fossette is thick, being 57 mikra at the bottom. There is no groove representing the organ of Jacobson.

The superficial layer of epithelium contains cubical or cylindrical cells distributed to the bottom of the fossette and the internal wall. These cells have a central clear extremity, and their nuclei are about 10 mikra from the surface, while at the level of the internal wall their distance from the border is 5 mikra. This difference measures the lengthening undergone by the epithelial cells.

6 *Millimeters.*—The olfactory fossette is deep and directed vertically from below upwards. The organ of Jacobson appears as a depression in the form of a furrow placed on the internal wall towards its inferior third. At the level of this furrow, the cells are cylindrical and have a central clear extremity while elsewhere they are still round.

7 *Millimeters.*—The primitive palate is formed; the choana is covered behind by the bucco-nasal membrane. The organ of Jacobson has about the same disposition as in the preceding stage.

9 *Millimeters.*—The olfactory cavity is large, 1.06 mm. in total length; anteriorly it is opened for an extent of 60 mikra; the primitive palate measures 450 mikra in an anteroposterior direction and the choana 360. The cavity is pro-

longed behind the choana in the form of a cul-de-sac flattened transversely.

It has a height at the level of the choana of 857 mikra and an average length of 42 mikra, but it is enlarged transversely by a fissure directed outward and separating the two projections of the external wall from one another. The inferior projection, anlage of the maxillo-turbinal, begins 90 mikra behind the anterior extremity of the cavity and continues for a length of 780 mikra. The ridge situated above, the naso-turbinal, does not begin until 195 mikra behind the anterior extremity of the maxillo-turbinal and has a length of 585 mikra.

Behind the naso-turbinal, the dorsal region of the cavity is enlarged and lodges the ethmoidal turbinals. One, very large, is inserted on the external wall; the other, less projecting, is situated on the superior wall. They do not reach the posterior extremity of the cavity.

The sensory epithelium covers the posterior segment of the cavity, the ethmoidal turbinals and, in front of these, the nasal roof and the portion of the external and internal walls adjoining. Its thickness reaches 50 mikra at the level of the nasal roof.

The organ of Jacobson has a length of 217 mikra; it begins 465 mikra behind the anterior extremity of the nasal cavity and opens into a furrow 83 mikra in extent; in the remaining portion of its extent it is an isolated cylindrical canal in the septum. The average diameter of the canal is 78 mikra and of the lumen 35.

17 *Millimeters.*—Differences exist in the dimensions of the nasal cavity, but especially in the extent of the turbinals. The maxillo-turbinal is a large ridge, the naso-turbinal is very distinct; the ethmoidal turbinals are inserted one on the external wall, and two on the superior wall.

MAN. 8 *Millimeters* (from the 28th to the 30th day).—The olfactory anlage is already quite a deep fossette which is transformed posteriorly into a cylindrical canal by fusion of the lateral mesodermic buds. This fossette is open for a length of 320 mikra; its situation is the same as that of other mammals.

The fossette measures 335 mikra in depth where it is largest and 71 mikra in average width. It is closed for a distance of 140 mikra and it forms behind a solid epithelial cord.

The internal wall and bottom of the groove has a superficial layer of cubical cells with clear protoplasm, very fine reticulum and basal nucleus. The other cellular layers are formed of round cells; epithelium is 85 mikra thick at bottom of the groove.

19 *Millimeters* (middle of the second month; Fig. 50). —The nasal organ opens on the dorsal surface of the cephalic region but in its anterior segment it has no lumen, and it is composed of an epithelial mass which a regular and more sunken layer separates from the surrounding mesenchyme. This peripheral layer is continuous with the ectoderm and the epithelial mass projects on the outer side of the fossette. The region covered by this epithelial mass has a length of 330 mikra. Then the lumen begins at the center of the mass

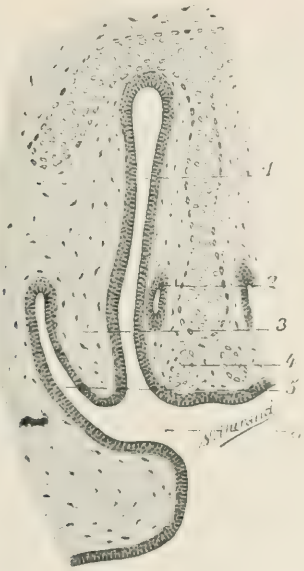

Fig. 50—X 34.3. Human embryo 19 mm. long from vertex to coccyx (middle of second month of pregnancy), (transverse section, right side). 1. Nasal cavity; 2. Organ of Jacobson; 3. Inferior turbinal; 4. Paraseptal cartilage; 5. Fissure limiting the inferior turbinal below; 6. Primitive choana.

and increases from before backward. From the beginning of the region provided with the lumen, the external wall presents a convex ridge intercepted by two fissures, which penetrate into the mesoderm. This ridge, the inferior turbinal, has a length of 230 mikra. In its middle portion there is only one inferior fissure present, circumscribing the ridge (Fig. 50), while at its posterior extremity there is only one superior fissure; this is directed deeply downward and outward, detaching the turbinal from the wall. The external wall presents a slight ridge in its superior region, at the level of the posterior extremity of this turbinal; opposite to this ridge, the septum is thickened, causing the lumen to be reduced to a simple slit, but the segment thus constituted has an anteroposterior extent of 70 mikra.

The organ of Jacobson is much advanced in its development, beginning 440 mikra from the anterior extremity of the cavity. It forms a depression on the internal wall only for a short distance. It is closed and separated from the wall for the remainder of its extent. It is 200 mikra long, its vertical diameter is 271 and its transverse is 121. It lies 394 mikra above the inferior border of the septum. Two small paraseptal cartilages lie below the septal cartilages.

The primitive palate is 220 mikra long and the choana 360 anteroposteriorly. Behind the choana, the cavity is nothing more than a vertical slit.

24 *Millimeters* (end of the second month).—The general arrangements are analogous to those of the preceeding stage: there is an epithelial plug; on the external wall, there is a ridge destined to provide the inferior turbinal; the superior portion of the cavity is covered with very thick epithelium; finally, the organ of Jacobson has the same place in the septum and the same relations with the nasal wall.

The cartilaginous envelop is slightly more extended. The two choanae unite in a region limited by the palatal buds and obstructed in part by the ridge of the tongue. This passageway has a width of 1.37 mm. and a length equal to that of the choanae, 1.20 mm. The inferior turbinal projects into this passageway, the groove which limits it inferiorly being situated, depending on the position, at a distance of 75 to 150 mikra below the inferior border of the septum. The latter reaches 1.12 mm. below the inferior border of the palatal buds. At a distance of 560 mikra behind the anterior extremity of the choana, the external wall presents, in its superior segment, a less prominent ridge, 175 mikra long, covered by epithelium thicker than that of other points of the wall—this is the primary anlage of an ethmoidal turbinal.

32 to 40 *Millimeters—Horizontal Sections* (6th day.)—The nasal cavity ends below in a passageway in which it joins with that of the opposite side. On the external wall are found projecting portions, marked by grooves, which give rise to the inferior turbinals and the ethmoidal turbinals. The ethmoidal region lies in the upper half of the cavity only, and its extent increases from below upward. It decreases again towards the apex of the cavity, in which it has the form of an anteroposterior furrow 750 mikra long. Above the primitive palate, in

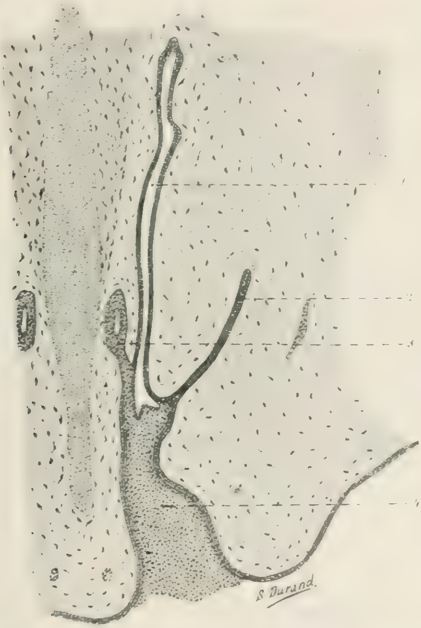

Fig. 51—X 20. Human embryo 32-40 mm. long beginning of third month), (horizontal section, left side). 1. Nasal cavity; 2. Epithelial bud limiting the area of the inferior turbinal, anteriorly; 3. Organ of Jacobson; 4. Vestibular epithelial plug.

the more extended region, the cavity measures 2.87 mm.; at this level, the ethmoidal region is 950 mikra long on the external wall.

The cavity is longest above the primitive palate, but it is not provided with a lumen throughout its extent, the anterior portion being occupied by the epithelial plug (Fig. 51). The length of the lumen is 2.25 mm.: the epithelial plug measures 1.50 mm. anteroposteriorly and 600 mikra transversely; its thickness or height is 403 mikra. The epithelial plug is limited laterally by a more depressed cellular layer, which continues the lateral nasal wall and unites with the ectoderm; it forms a ridge at the level of the external orifice.

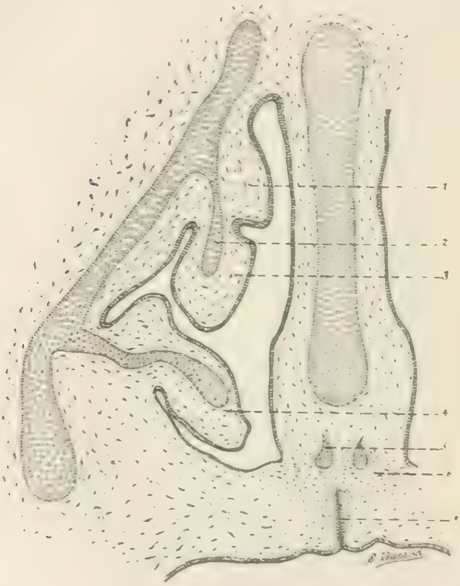

Fig. 52—X 20. **Human embryo 47-60 mm. long (middle of third month), (transverse section, right side).** 1. Superior turbinal; 2. Cartilaginous axis of middle turbinal; 3. Middle turbinal; 4. Inferior turbinal; 5. Paraseptal cartilage; 6. Fusion of septum and palatal laminae; 7. Fusion of palatal laminae.

The cavity has a length of 2.87 mm. above the epithelial plug and the ethmoidal region measures 950 mikra on its external wall. The cavity is limited below the plug, anteriorly, by the primitive palate, and is represented only by the palatal cleft, the length of which is 2 mm. The anteroposterior extent of the primitive palate is 1.62. The internal wall sends out the canal of Jacobson in the region provided with lumen, at the level of the plug. The section passes anteriorly across one of the walls of this organ and behind influences the lumen (Fig. 51). Its junction with the cavity is 1.60 mm. from the external orifice.

The cartilaginous skeleton, incomplete in the inferior and medial regions of the cavity (septum and lamina isolated in the mesenchyme of the external wall), forms a complete envelopment in the superior region.

47 to 60 *Millimeters* (76th day; Fig. 52).—The nasal cavity has already acquired the form which it will have in the adult; it is provided with a lumen throughout by virtue of the almost complete resorption of the anterior epithelial plug. It has three turbinals with the beginning of the maxillary sinus. The inferior turbinal is 3.32 mm. long, the middle turbinal 2.19 mm., beginning 670 mikra behind the anterior extremity of the inferior turbinal; the superior turbinal is 1 mm. long and begins 1.13 mm. from the anterior extremity of the middle turbinal; all the turbinals are inserted upon the external wall (Fig. 52).

The lachrymal canal, composed of a solid epithelial bud, opens in the groove which limits the inferior turbinal below.

The groove which separates the inferior turbinal from the middle is dilated into the shape of a flask at its bottom and forms a recess 780 mikra long, 875 high and 200 wide; it represents the beginning of the maxillary sinus. The skeletal lamina of the external wall limits it externally (Fig. 52). The organ of Jacobson is no longer in communication with the nasal cavity; it has the same position in the septum commencing 1.5 mm. behind the external orifice, and being 240 mikra long. It forms a solid cellular cord at its anterior and posterior extremities.

The epithelial plug, which obstructs the anterior portion of the cavity in the preceeding stages, is very much reduced; at the entrance of the external orifice, it occupies scarcely the inferior third of the cavity and it diminishes in importance from before backwards, being represented only by an irregular mass, attached to the internal and inferior walls.

Some vestiges of the plug exist for a length of 1.4 mm.

The cells which constitute it are large, polyhedral and very clear, having a mean diameter of 12 mikra; the protoplasm is not stained by carmine; the cellular border is barely visible; the nucleus is smaller than that of the epithelial cells of the wall, irregularly colored, presenting portions that are clear and portions that are depressed.

The skeleton forms a thick lamina limiting the cavity externally and giving an axial lamella for each turbinal, that of the superior being very short; the septum lies internal. The two small paraseptal cartilages are placed below this (Fig. 52).

The primitive choanae no longer exist, and palatal laminae separate the buccal cavities from the nasal cavity. Fusion of the two palatal laminae is still indicated by a vertical epithelial band in the median line. the septum is fused throughout with the palatal laminae and the zone of union is marked by denser and more colored mesenchyme (Fig. 52). The palatal laminae (secondary palate) have a thickness of 600 mikra while the primitive palate (in the region of the epithelial plug) measures 1.45 mm.

80 to 100 *Millimeters* (beginning of the 4th month).—The turbinals and the anlage of the maxillary sinus have the same arrangement as in the preceding stage. Some osseous spaces appear in the palatal laminae in process of organization. The organ of Jacobson, which opens into the nasal cavity by its anterior extremity, has a length of 560 mikra and a diameter of 107 in its middle portion.

The epithelial plug still exists in the anterior portion of the cavity, but, as in the preceding stage, it is represented only by an irregular cellular mass distributed to the inferior third of the internal and external walls and to the floor of the nose.

Glands make their appearance in the form of epithelial buds arising from the internal and external walls. Some of these solid buds are adherent to the nasal epithelium, some isolated in the mesenchyme. Some, but rarely, are provided with a slight central lumen. Some have a length of 114 mikra, others of 150.

The lachrymal canal is permeable throughout almost its entire extent.

Numerous vessels are in the mesenchyme of the internal and external walls; they are particularly abundant along the superior boundary of the pedicle of the inferior turbinal.

160 to 235 *Millimeters* (middle of the 5th month).—Below

the middle turbinal, the external wall forms a small longitudinal ridge containing a cartilaginous ridge, representing an accessory turbinal, the fourth ethmoidal turbinal. The maxillary sinus is very well developed; it is almost entirely surrounded by bony walls formed by the superior maxillary. It extends vertically between the axis of the inferior turbinal and that of the middle turbinal; it is covered by an epithelium analogous to that of the nasal fossae; between the epithelial wall and the bony wall is found connective tissue containing vessels and glandular buds. This connective tissue layer has a thickness of 300 mikra.

The sinus in almost all the transverse sections is divided into two compartments; we have been unable to find the point of communication between the sinus and the nasal cavity.

Numerous glandular buds are found throughout the nasal cavity, particularly over the inferior turbinal; they are branched, representing the beginning of clusters of glands. They are provided with a lumen, reaching a length of 575 mikra.

The organ of Jacobson is of reduced dimensions; its mean diameter is 160 mikra.

BEGINNING AND EVOLUTION OF THE OLFACTORY ORGAN.—We find the ectodermic thickening corresponding to the nasal field of His in 5 millimeter embryos of the guinea pig, 4 millimeter mole and 8 millimeter sheep.

The cells which compose it have the embryonic form, round and pressed upon one another; nevertheless the cells of the superficial layer already show the onset of differentiation; they are elongated, the nucleus is basal and removed from the surface; the protoplasm is clear with a fine network of barely visible granules scattered through it.

The thickening hollows into a fossette which sinks into the mesoderm, at first dorsoventrally, then enlarges anteroposteriorly. This fossette is limited laterally by mesodermic masses or nasal buds. According to Koelliker, Dursy and His, the nasal and superior maxillary buds fuse and for a small distance close the nasal cavity below. The zone in which this fusion is made is the primitive palate. Anteriorly, the fossette is widely open and posteriorly, in the form of a cleft, it corresponds to the buccal depression. This cleft is the primitive choana or palatal cleft of Dursy.

Hochstetter (1891 and 1892) has shown in the cat, rabbit and man, that the palatal clefts are not open at the beginning but are closed by an epithelial membrane which he calls the bucco-nasal membrane. The choanae are formed by absorption of this membrane.

Keibel (1893) confirms the exactness of Hochstetter's description in the human embryo and Peter (1902) in the rabbit. We have found this bucco-nasal membrane in the guinea-pig, sheep and mole; it is a very thin pellicle formed of a thin layer of flat cells extending from one border of the choanal fissure to the other. It is still present in the guinea-pig of 14 mm. and in the sheep of 15.

Later, the primitive choana unites no longer with the buccal cavity, the latter being separated from the nasal cavity by the secondary palate (palatal laminae of Dursy). In the human embryo of 24 mm., we have shown that the lower limit of the maxillo-turbinal is subjacent to the septum situated in the bucco-nasal passageway which receives the two choanae. This shows us clearly that the superior region of this passage will later belong to the nasal cavities. The palatal buds, visible from the stage of 19 mm. in the human embryo, are directed at first obliquely downwards; the tongue, occupying the entire height of the buccal cavity, comes almost in contact with the septum, and it is not possible that the palatal laminae are developed from within. As has been well noted by Dursy (1869), the tongue is later drawn downwards and the palatal processes take a horizontal direction. According to Mihalkovics, they begin to fuse towards the ninth or tenth week.

In a human embryo of 47 to 60 mm., fusion of the palatal laminae is affected throughout the primitive choanae and they are at the same time united with the nasal septum (Fig. 52).

The nasal septum sinks down anteriorly between the palatal laminae; the fusion persists in the zone of contact under the form of an epithelial band directed obliquely inwards and downwards and placed near the median line. A lumen appears later in this tract and thus establishes a communication between the nasal and buccal cavities; the canal thus formed is the canal of Stenson (Peter 1902, 1903).

The growth of the nasal buds and the superior maxillary, and, consecutively, the extension of the primitive palate cause modifications in the neighborhood of the internal orifice. It is closed in all parts and forms an elliptical opening on the facial plane.

The nasal canal is lengthened anteroposteriorly in the passageway of the fused buds. The epithelial buds grow and a long epithelial plug appears, obliterating the cavity at this level; this plug forms a ridge at the level of the external orifice by resorption of the central cells (process observed in reptiles and birds); this mass is penetrated by the nasal lumen from before backwards. (See human embryo, stages of 24, 32 to 40, and 47 to 60 mm.)

This is the plug in which Laguesse (1885) could most easily follow the mucous transformation which precedes the appearance of ciliated cylindrical cells. This writer has studied minutely the histogenesis of the respiratory epithelium; the embryonal cells in the nasal cavity are changed; large vacuoles appear on the surface of their protoplasm, filled with a transparent mucous liquid; other cells, uniformly granular and containing one or two vacuoles, are supplied with cilia on their surfaces. Laguesse notes a very incomplete mucous transformation in the region of the olfactory spot.

The turbinals appear very early: mole of 9 mm., sheep of 15, very clear in guinea-pig of 12, slightly outlined in human embryo of 19.

According to our observations on the guinea-pig, the sheep and the mole, a turbinal is developed on the inferior half of the external wall (maxillo-turbinal), another on the superior half of this same wall (naso-turbinal; Figs. 46 and 48).

These two turbinals have in common the disposition of being extended anteroposteriorly in the anterior and middle regions of the nasal cavity.

Other turbinals are formed in the posterior region of this cavity, one on the external wall and two or three on the superior wall (ethmo-turbinals; Figs. 46 and 49).

The turbinals take their origin from the parietal processes limited by fissures or grooves. The process which we have followed in reptiles is found in mammals; it has been observed by Schönemann (1902), Strasser (1901) and Karl Peter (1902-1). It is clearly visible in different embryos at the beginning of the development (rabbit, sheep, guinea-pig).

The initial phenomenon is fissuration of the epithelial buds, arising from the nasal wall and extending into the surrounding mesenchyme; later the buds, isolated from the wall, increase in dimensions by growth of the mesenchyme which they enclose.

In order to classify the turbinals, Peter used their origin as a basis: the maxillo- and naso-turbinals orginiate from the external wall and the ethmo-turbinals from the inner wall. This writer observed the internal wall divided, in the rabbit, into two portions by an angle of flexion (Knickung der medialen Wand), the superior portion being destined to furnish the ethmoidal turbinals.

This observation of Peter is correct. We have followed the transformations of the internal wall in embryos of the sheep of 14 (Fig. 47) and 15 mm. (See stage of 14 mm.) A longitudinal furrow exists towards the superior third of this wall in the 14 mm. embryo, below which the wall is vertical and the epithelium thin, while above it the wall, formed of thick epithelium, is inclined obliquely upward and outward; the groove is the apex of a dihedral angle whose sides are formed by two segments of the internal wall.

The groove, in the 15 mm. embryo, becomes a very deep fissure, which prolongs the nasal lumen above; the internal wall is vertical, and there is a wide superior wall with convexity inferiorly, which results from the displacement of the superior segment of the internal wall.

All embryos which we have examined present ethmoidal turbinals on the superior wall and adjacent portion of the external wall. The superior wall has a segment of the primitive internal wall, causing the ethmoid turbinal field to have in large part a septal origin. Peter's classification depends on this fact, but it must be admitted that this shows only at the beginning of development, for at the time that the turbinals appear the change in position of the walls is already accomplished.

Nevertheless, Peter's distinction should obtain with reference to the naso-turbinal.

This turbinal, in fact, is more to be compared to the maxilloturbinal than to the ethmo-turbinals. It is not its insertion on the external wall that removes it from the latter, because certain of them take their origin there. It is on account of their early appearance and the anterior position of their field of origin, that makes it possible to group the naso-turbinal with the maxillo-turbinal.

This distinction (anterior turbinals and posterior turbinals) persists in the adult except in man, in whom the anteroposterior shortening of the facial framework causes the different turbinals to be superimposed vertically.

The ethmoidal turbinals, inserted on the ethmoid, grow anteroposteriorly in such a manner as to present an anterior free extremity. There are only three turbinals in the stages which we have studied in the different mammals; others are formed later; we have seen that the number varies in adults. Killian finds six grooves limiting six olfactory processes in human fetuses from 9 to 10 months.

The first will form the agger nasi and the uncinate process; the others, from 1 to 5, the ethmoidal turbinals. Besides these turbinals, Killian finds accessory turbinals (conchae obtectae) in the principal grooves and in addition the processes may present accessory grooves.

Generally, six processes are rare in man: Zuckerkandl describes four which he finds in the adult (see Morphology). According to Wiedersheim (1902), the reduction of the number of turbinals in man is caused by the ascending branches of the ethmo-turbinals and by effacement of the primary grooves.

He establishes, thus, the origin of the different olfactory turbinals in man: inferior turbinal = inferior process; middle turbinal = descending branch of the first principal turbinal + a small portion of the ascending branch; superior turbinal = descending branch of the second principal turbinal or of the second, third and fourth turbinal; supreme turbinal (Santorini) = descending arm of the third and fourth turbinal.

The development of the sinuses is given in a large number of works; Dursy (1869) was the first to show that the accessory cavities of the nose originate at first under the form of diverticula of the mucosa surrounded by cartilage, without bony walls at the beginning. According to Koelliker (1882) the sinuses of the mucosa, enveloped by cartilage, extend, and the neighboring bones form simply an external envelope; then the cartilaginous capsule disappears without ossifying, and beginning with that time the cavities are immediately limited by the bones.

As Schönemann, Strasser and Mihalkovics have established, there are certain fissures which preside over the formation of the turbinals which give origin to the sinuses.

Rémy (1878) established the appearance in man of the ethmoid cells first, then the maxillary sinus at 4 months, the sphenoid towards the end of the first year and the frontal sinus from 7 to 8 years.

Laguesse (1885) saw the beginning of the maxillary sinus in the sheep embryo of 3.7 cm., in the form of an invagination of the mucosa, directed from within outward and from behind forward.

We found the maxillary sinus and the ethmoid cells in a calf fetus of 11 cm.; the maxillary sinus appeared in the human embryo of 47 to 60 mm. in the form of an expansion of the groove separating the inferior turbinal from the middle turbinal (Fig. 52).

The sphenoidal sinus is formed by isolation of the posterior region of the cavity under the influence of fusion of the different ethmoidal turbinals; this process is to be observed in the guinea-pig and sheep.

According to Killian, the ethmoid cells originate from the groove situated between the olfactory processes; the third groove gives origin to one cell; the second to two cells, one superior and one inferior; from the first division arise: a superior recess giving origin to superior ethmoid cells, an inferior recess, to the inferior cells of the lachrymal; from this groove, also, the frontal recess arises.

Steiner (1871) considers the appearance of the frontal sinus as connected with the beginning of the cartilaginous ethmoidal labyrinth. The development of the frontal cavity begins with that of the cellular spaces of the anterior ethmoid labyrinth; it is established between the first and second year. The type of development under the influence of the ethmoid labyrinth is conserved in the adult cranium.

Mouret (1901) concludes from a long study of the frontal sinuses that they are formed by the extension of an ethmoid cell into the thickness of the frontal; inasmuch as the cells concerned are not always the same, the excretory orifice of the sinus does not always occupy the same place and is not always at the extremity of the fossa of the infundibulum. The formation of frontal bullae and of supplementary frontal sinuses is very well explained by extension of the different ethmoid cells.

Killian has already admitted the possibility of the origin of the frontal sinus being dependent upon the different olfactory grooves.

Laguesse observed the appearance of glands in a sheep embryo of 3.5 cm. under the form of epithelial buds.

The lateral nasal gland discovered by Steno, observed in its evolution by Jacobson, Kangro and Schwink, is established at various periods: before the formation of the cartilaginous cranium (goat, rabbit), after the beginning of ossification (calf). It originates at the level of the anterior extremity of the nasoturbinal, at the commencement of the middle meatus, in the region of the sensory epithelium. Kangro, in the elan, finds a glandular depression in the superior meatus. On account of its origin in sensory region, this gland, according to Peter (1902-3), cannot be homologized with the lateral gland of reptiles.

The septal gland appears, according to Schwink, in a mouse embryo with a head length of 8 mm. and in the rabbit of 68.

We see glands appear in the human embryo at the stage of from 8 to 10 cm. in the form of solid epithelial buds issuing from the internal and external walls; certain among them are provided with a small central lumen.

The organ of Jacobson appears very early (sheep of 10 mm. mole of 6). It is a furrow covered from its beginning with differentiated cells and soon is transformed into a cylindrical canal (sheep of 14 mm.) for a large portion of its extent. Towards its anterior extremity, a portion of the primitive choana (canal of Stenson) persists in order to establish communication with the buccal cavity. Placed below the septal cartilage, this organ is in relation internally and inferiorly with the cartilage of Huschke or of Jacobson. In the human embryo of 19 mm., this organ is placed above the inferior border of the septal cartilage, remote from the cartilage of Huschke (Fig. 50). This is according to the description of Dursy, Koelliker, Garnault, Mihalkovics and Tourneux. Gegenbaur, by reason of the elevated situation of this canal and its distance from the paraseptal cartilage, considers that it acts as the excretory canal of a septal gland. Garnault and Mihalkovics, on the contrary, do not admit the necessity of any relation between the organ and the cartilage. In the series of mammals, the organ of Jacobson has not always the same destiny; it grows, conserving its relations in the majority of the groups, while it disappears in certain others (Cheiroptera, man).

CHAPTER III.

GENERAL CONSIDERATIONS.

Olfactory Anlage.—The nasal cavities of vertebrates are derived from ectodermic thickenings depressed into fossettes; these close by approximation of the borders which limit them, but always preserve an external opening, at the level of which their wall is in continuity with the external layer. These are distinguished thus from identical formations; crystalline lens, auditory vesicle.

They come into relation with the digestive tube (air-breathing animals) by its ectodermic portion (buccal fossette). There are no primitive relations in any vertebrate with the entodermic layer. This fact makes it possible to refute the view of Dohrn, who considers the olfactory cavity as the first branchial cleft, inasmuch as the branchial clefts present an ectodermic and an entodermic portion in their formation.

The olfactory apparatus is distinguished from other sensory apparatuses by special characteristics. The organs of sense, with the exception of taste and the tactile sense, offer peculiarities in the disposition of the corresponding nerve system. In the auditory apparatus, the auditory nerve takes origin in the peripheral nervous ganglia (ganglia of Scarpa and Corti), placed in the neighborhood of the mucosa which perceive the sound waves. In the optical apparatus, a portion of the central nervous system is evaginated and constitutes a sensory membrane in the peripheral perceptive apparatus, viz., the retina. In the olfactory apparatus, the ectodermic cells cover the nasal depression, and are evoluted into the type of nerve cells. In the corresponding zone, the entire thickness of the ectoderm is used for the development of the olfactory organ. The olfactory cell gives origin to two nervous prolongations, the one protoplasmic (olfactory cilium) which receives the external sensations; the other, an axis cylinder which transmits them to an intermediate neuron (cells of the olfactory bulb) having the functional value of a nerve cell.

Cellular Modifications.—The differentiation of cells of the ectoderm into cells of the nasal epithelium is effected very early (Pristiurus of 7 mm., trout of the 34th day of incubation, tadpole of the toad of 10 mm., blindworm of 25 mm., parrot of 8.5 mm., sheep of 8 mm. and mole of 5 mm.).

At the beginning of development, we find the same modifications in all points of the nasal cavities; only their date of appearance distinguishes the different zones. The first cellular transformations are found in the bottom of the fossette on the internal wall and in the organ of Jacobson. They occur in the cells of the most superficial layer. The cells which begin to elongate have first a cubical form, their protoplasm becomes refractive, forming a thin and lightly colored tract of meshwork; the cellular limits are barely marked by granular borders which stain slightly with carmine; the border towards the central extremity is thicker and more depressed. The nucleus of the cells becomes basal and removed from the surface.

The cellular height is increased in the succeeding stages and the cells take on a cylindrical form; the protoplasm is less clear and refractive and of a grayish rose color. The sensory cells take on the same color as the central nervous system.

APPEARANCE OF THE OLFACTORY NERVE.—The nerve fibres which unite the nasal epithelium to the olfactory bulb appear a little later than the cellular transformations (Petromyzon of 3 to 4 mm. according to Kupffer; selachians of 13 to 14 mm, according to Hoffman; tadpole of toad of 13 mm., blindworm of 25 mm.).

The anlage of the olfactory nerve is formed by the tract of fine fibrillae, distinguished in the solid mesenchyme by their clear yellow color and by the infrequency of the cellular nuclei; these are round, some being elongated in the direction of the fibrillae. They are scattered throughout the extent of the nerve and divided from one another as in the peripheral portion of the central nervous system. The fibrillae are lost in the middle of the epithelial cells at the nasal wall and the organ of Jacobson.

RESISTANCE OF THE OLFACTORY SENSE.—No accessory organ is interposed in the nose between the external medium and the perceptive neuron.

The olfactory epithelium is protected only by its situation at the bottom of a cavity whose communication is made with the exterior only by one or two narrow orifices, valves or muscles, capable of arresting up to a certain point, the water or air current which conveys the odorous particles. But these are so subtle that it is impossible to abstract them completely. Although the sense is poorly protected, it is on the contrary very resistant and the abundance or intensity of the impressions makes its study difficult. It is at the same time endowed with great resistance and extreme sensibility; association of these two qualities is possible on account of the simplicity of its structure and the high morphologic value of the cellular elements which constitute it.

DISPOSITION OF THE OLFACTORY MUCOSA.—With this simple structure, how is the olfactory apparatus arranged? It is located in a cavity forming more or less extended folds. In fish, the nasal cavity contains numerous lamellae which subdivide it into spaces, radiating and parallel to one another. The surface is greatly augmented by reason of these lamellae. The odorous particles dissolved in the water may make an impression on this large olfactory field.

The phenomenon of olfaction appears analogous to that of gustation; the existence of olfactory buds in certain groups of bony fishes certifies to the identity of the two orders of sensation. The dissolved state of the odorous particles necessitates direct contact between the water which contains them and the olfactory mucosa; diffusion must be less easy than if the substances were in a free, gaseous state. With the surface increased in extent, contact will be more certain; the increase in the surface is attained by the presence of the lamellae.

In air-breathing animals, the olfactory mucosa is located in a special region of the nasal cavity. In the lowest forms, this region is very extensive compared to the total surface of the body. It is not possible in Urodela to disinguish an olfactory and a respiratory region; likewise in Perennibranchia (axolotl), the mucosa has folds which approximate those of fish. In Anura, on the contrary, the structure is not homogeneous throughout the cavity, and the olfactory and respiratory regions may be clearly distinguished (middle and infero-external culs-de-sac). A similar disposition exists in Sauropsidia, but the respiratory region, in place of separating in the form of a cul-de-sac, extends into the zone subjacent to the turbinal.

In all of the other groups, beginning with the crocodiles, the olfactory surface does not extend a great distance into the cavity but it is enlarged by the presence of folds or ethmoidal turbinals. The increase occasioned by the presence of these turbinals is very marked in mammals. The olfactory surface is one and a half times larger in man and four times in the sheep, what it would be without the turbinals.

Ethmoidal turbinals of mammals and lamellae of fish have therefore the same function.

UTILITY OF THE EXTENSION OF THE OLFACTORY MUCOSA. —Is it necessary for the sensory mucosa to be very extensive to satisfy the sense of olfaction?

The organs of sense, says Lacépede, are instruments added to the body, so to speak, of the animal, without being an essential part of it; their proportions and dimensions have a relation only in accordance with the nature, force and number of sensations which they should receive and transmit to the brain. The dimensions of the eye or the ear are not proportionate to the body of the animal and their large size does not indicate functional perfection (a large eye is myopic); but the eye and ear are complex organs organized to receive adequate impressions by virtue of accessory apparatuses. Perfection of architecture excludes extension of the organ.

These conditions are not the same for the organ of olfaction. This is directly impressed by the external sensations, and it will be more apt to receive them when the sensory surface is more extensive. There is no concentrating apparatus here for the purpose of grouping and selecting sensations. It is for this reason that the size of the olfactory region gives us an idea of the development of the corresponding function. Since the odorous particles come mixed in the respiratory air, the olfactory sensations will be the more intense when a greater volume of the current of air enters in contact with the sensory surface.

Thus a positive importance is to be accorded in the relation of the extent of the olfactory with the respiratory region.

EXTENSION OF THE RESPIRATORY REGION.—The useful amplitude of the nasal cavity respecting the respiratory function depends especially on the height and width. Is it necessary that the respiratory mucosa should be increased by an architectural process? The utility of this extension is altogether secondary. In Amphibia, the respiratory cavity increases by formation of an important cul-de-sac (infero-external cul-de-sac); this process is found in reptiles, birds and mammals, in which the cavity is increased by hollowing out of fissures which are directed externally. But these present between them portion of the wall which, when the fissures are formed, form larger or smaller ridges. These ridges or turbinals increase the respiratory surface as the ethmo-turbinals increase the olfactory. The mesoderm remains passive in the formation of the turbinals, and the active process devolves upon the nasal cavity which is enlarged. The epithelial processes sink into the surrounding mesenchyme preceding the appearance of the fissures.

The increase of the respiratory surfaces has the function of utilizing the qualities of the mucosa which covers it. This is ciliated; the vibratile cilia constitute a mechanical protective apparatus, a sort of moving brush which throws out the solid particles contained in the inspired air. The greater the extent of the surface covered with cilia, the greater will be the purification of the air.

Besides this, by virtue of the presence of the subchorial vascular lacunae, the air which is in contact with a large vascular surface, will be heated while passing through the nasal respiratory canal. The filter function of the turbinal is well shown by the disposition of the maxillo-turbinal in the badger; it is really a sponge closing the respiratory region, through the meshes of which the current of air is compelled to pass.

The mucosa, with the double function of filtering and warming the air, is protected in its turn from the action of current of air by the presence of glands, the mucous glands extracting particles and microorganisms, the serous glands causing humidity of the surface.

Turbinals.—Turbinals exist in all classes from reptiles to man, but they vary frequently in their disposition. The respiratory may be distinguished from the olfactory; the former are disposed in the anterior portion of the nasal cavity, the latter in the more posterior.

We may classify them in the following way:

	Man.	Mammals	Birds	Reptiles
1. Valvular turbinal (external orifice)			Vestibular turbinal	
2. Respiratory turbinals (anterior)	Inferior turbinal, Agger nasi	Maxillo-turbinal Naso-turbinal	Middle turbinal	Turbinal
3. Olfactory turbinals (posterior)	Middle turbinal, Superior turbinal Bulla ethmoidalis	Ethmo-turbinal	Superior turbinal	Pseudoconcha of the crocodile.

The turbinals are complicated in two ways, by coiling or by ramifications. The inferior turbinal is especially concerned in these modifications, which are less accentuated in the naso-turbinal and the ethmo-turbinals. Strasser has established a law which regulates the disposition of the turbinals: The inferior turbinals are directed so that their lamellae lie in the direction of the current of air, their fissuration being longitudinal, while the layers of the baso-turbinal and the naso-turbinal appear directed dorsoventrally, the fissuration being in the direction of the branches of the olfactory nerve. This law cannot be generalized for, with the exception of Carnivora and Proboscidia, which have the middle and the superior turbinals cut into lamellae, the other mammals have the naso-turbinal and the ethmo-turbinals formed by simple ridges elongated from before backwards. The classification of turbinals which we have given is not absolutely exact, for the middle turbinal of man is deprived of its olfactory epithelium on its inferior surface and a part of the superior surface, and on the other hand the naso-turbinal often has olfactory epithelium at its posterior extremity.

SINUSES.—The process of enlargement of the nasal cavity which causes the formation of the turbinal creates the diverticular cavities which are disposed in the bones of the face. These diverticula increase parallel to the skull, but their orifice of nasal communication becomes narrower and they are separated so to speak from the cavity of which they are only expansions. They are the sinuses or accessory cavities.

In the amphibians, the external or inferoexternal cul-de-sac is the first step made in the way of respiratory enlargement. The sauropsidians present a small external recess and the crocodiles a very large maxillary sinus. In birds, the pneumatic spaces are numerous around the nasal cavity as well as around the entire respiratory apparatus. In mammals, the sinuses exist in all groups, but with variations in their extent and in their topography. The sinuses appear relatively late; we have seen the maxillary sinus begin in a human embryo of 47 to 60 mm., and we have met it quite large in a calf of 11 cm. The sphenoidal sinus is present in a calf of 14.5 cm.

The frontal sinus appears at the age of 7 or 8 years in man. The role of the sinuses in olfaction is absolutely nil. Odorous particles carried directly to the mucosa of the sinuses produce no impression; their lesions do not modify olfaction; the energy of the olfactory function is not increased at the age at which the different sinuses increase and at which the frontal sinus appears.

MORPHOLOGIC VALUE OF THE SINUSES.—The sinuses appear connected in their extension with the general volume of the head; it is thus that the maxillary and frontal sinuses are very much developed in herbivora which have a voluminous head extended in length in order to facilitate prehension of the food (pasturage being the process of alimentation in the natural state) and in width in order to permit the implantation of large teeth in the form of grinders. In the carnivora the teeth are powerful but slender, so the maxillary sinus is absent or slightly developed. On the other hand, the extent of the sinuses will proportionate the dimensions of the face with those of the cranium when it is voluminous, as in man for example.

Tillaux (1862), comparing the head to a vertebra, applies to its development a law according to which: "when one of two parts of a vertebra takes on a considerable growth, the other remains stationary and it acquires a relatively larger volume." So far as this concerns the head, since the skull attains large dimensions during the fetal period, the face should remain very limited. After birth, it is the face which encroaches most upon the cranium on account of the rapidity of its development. This result is achieved by the frontal and maxillary sinuses.

The ethmoidal and sphenoidal sinuses are connected in the extension of the olfactory apparatus (ethmoidal region). It is the ethmoid which requires a very large cavity to lodge it; the ethmoid cells are distinctly proportionate to the extension of the ethmoid; as to the sphenoidal sinus, it is a part of the olfactory region separated from the remaining portion of the cavity by fusion behind the primitive ethmoidal turbinal; the frontal sinuses are derived from the ethmoidal extension; according to Steiner, they are formed by the ethmoidal cells included in the frontal. Zuckerkandl does not admit that the frontal is formed from the ethmoid cells, but he considers that it is destined to contain them. The expansion of the nasal mucosa at the beginning of the development has the primordial role; later there will be an extension of the ethmoid which causes enlargement of the sinus.

FUNCTION OF THE SINUSES.—The function of the sinuses has been studied by numerous authors, but it is difficult to determine it definitely. Considering that in the elephant there are numerous and vast cavities which run through the bones of the cranium and of the face of this gigantic animal, it would seem that the sinuses have the function of lightening the skull, and of leaving to the disposition of the muscles very large surfaces for insertion corresponding to the muscular forces necessary.

In résumé, the accessory cavities at the beginning of their formation are destined to increase the respiratory region (maxillary sinuses) and the olfactory region (sphenoidal sinuses, ethmoidal cells and frontal sinuses). The ultimate growth, connected with the volume of the head, permits the extension of the osseous surfaces and the diminution of their weight.

They have, besides this, secondary functions. De Meyer (1885) explained how they served to warm the inspired air. According to Couetoux (1891), they have an important action in modifying the deformative effects of aspiration. According to De Cyon, the mucosa of the nasal cavities and perhaps of the frontal cavities have a function in the phenomenon of orientation at a distance. They have the function of a resonating chamber in the phenomenon of phonation; their favorable influence in phonation has been accepted by Spigen, Bartholin, Fallopius, Ingrassias, Lieutaud, etc.

They contribute the production of harmonic sounds which characterize the timbre of the voice. Their influence is very clear if one examines the voice of a soprano, and of the falsetto, which differ from one another only in the timbre. The former appertains to women whose face is very small, sometimes even small in relation to the stature and corpulence; falsettos, on the contrary, have a large and high face with pure but clearly marked lineaments; the frontal and maxillary sinuses contribute very decidedly in establishing these differences of conformation.

ORGAN OF JACOBSON.—The olfactory apparatus is enlarged in several groups of vertebrates by the formation of a sensory organ independent of the nasal cavity from which it has its origin (the organ of Jacobson). In the amphibian Anura, it constitutes a groove, deep and much extended antero-posteriorly, which throughout its length communicates with the nasal cavity and reaches posteriorly to the choana.

In the sauropsidian reptiles, the organ of Jacobson attains its maximum of development; it is an evagination of the nasal cavity, originating from the inferior border of the internal wall, detached early (3 cm. stage of the blindworm) from the nasal wall so as to be transformed into a canal which communicates directly with the buccal cavity.

In the crocodiles and chelonians, this organ exists only during embryonic life; in adult birds, it is entirely absent and we cannot be sure of its existence in the embryonic anlage.

It reappears in mammals and is well developed except in primates; it is absent in the human adult. Its communication with the buccal cavity is formed by the intermediation of the nasopalatine canal.

What is the significance of this organ?

According to Cuvier, it is destined to distinguish useful alimentary particles from those which are not. According to Koelliker, it serves to recognize the chemical composition of the body juices. Seydel accords to it the function of sensory control of the expiratory current. Mihalkovics refutes these different views and claims that this organ is designed to perceive the genital odors and for this reason it is well developed in crawling animals and absent in birds and fish, which are accommodated by their visual apparatus, and atrophied in man on account of the development of the intelligence.

It appears to us more reasonable to consider it as related to the function of taste. Its communication with the buccal cavity justifies this function; on the other hand, it is absent in birds in which the buccal cavity communicates with the olfactory region by the long choanal fissure. It must have a function in the selection of food rather than in the appreciation of taste, for it is developed at the maximum in snakes, animals which do not linger to enjoy their food.

We recall, therefore, the old theory of Cuvier.

PHYLOGENETIC RELATIONS BETWEEN THE DIFFERENT VERTEBRATES.—There are two aberrant groups at the bottom of the scale of vertebrates: Cyclostomes and Amphioxus.

The latter is clearly monorrhinal and the olfactory fossette is united in its formation with the hypophisial diverticulum.

The cyclostomes are parasites in which the whole face is occupied by an immense, circular mouth. The olfactory organs are pushed back upon the dorsal surface and are fused in the middle line. The enormous extension of the superior lip (or more exactly of the superior border) forces the nasal organ to move back upon this dorsal surface and to be placed near the neuropore.

The primitive amphirrhinia is indicated by the duplexity of the olfactory nerve. These animals have been amphirrhinal and it is not necessary that the other vertebrates should have been primarily monorrhinal (at least this is not demonstrated by any other group). The amphirrhinia is normal and primordial while the monorrhinia is regressive.

Certain cetaceans appear to be monorrhinal on account of the imparity of the blow-hole. This only appears so, for both cavities end in common in a sac and in a vestibule conducting it to the external orifice. In the cetodonts, in which the skull is asymmetrical, the nasal fossae participate in this deformity: one of the nasal fossae (the right in the cachelot) opens now only at the level of the nares, being atrophied. The left naris gives rise to the blow-hole and by secondary connection, the right nasal cavity opens into that of the left side. It is for this reason that the orifice of the blow-hole is deviated to the left. There can be no question of nasal imparity in this case. The nasal fossae, according to Abel (1902), have a very important function in the deformity of the skull of the cetaceans (Odontocetes), in which the asymmetry is so much more manifest when the nasal cavities pass further back towards the cranium.

Asymmetry is found in man under the form of septal deviations; this appears about the age of 7 or 8 years or later; it is caused by an exaggeration of the asymmetry of structure under the influence of nasal inflammations.

The group of water-breathing vertebrates is connected with that of the air-breathing vertebrates by the lower amphibians (Proteus and Axolotl) ; the Axolotl, having a naso-buccal orifice, presents folds of the nasal mucosa which approximate the nasal orifices of fishes.

GENERAL RESUME.

The study of the olfactory apparatus suggests to us the division of the vertebrates into two great classes: I. Water-breathing, and, II. Air-breathing.

MORPHOLOGY.—I. The olfactory apparatus of water-breathing animals is disposed in a cavity opening externally, which it occupies in toto. The cavity may be single (1) or paired (2). (1) The single cavity is found in amphioxus, in which it forms a simple, ciliated fossette placed upon the left side of the anterior extremity of the animal, and in the cyclostomes in which it lies in the median line of the dorsal surface, immediately in front of the cranial capsule. It opens externally by a single orifice, infundibular (Ammocoetes) or carried on a small membranous tube (Petromyzon). Below and behind, the cavity is prolonged into a canal terminating in a cul-de-sac on the superior wall of the digestive tube (Petromyzon) or even opening into the latter (Myxine). The cyclostomes, in spite of the imparity of their nasal organs, possess two olfactory nerves; furthermore, in the Ammocoetes, an incomplete median septum (dorsal lamella) divides the cavity into two symmetrical halves.

(2) The double cavity belongs to the selachians, teleosts and ganoids. It opens externally by an orifice, single (selachians) or double (teleosts and ganoids). The single orifice of the selachians is functionally divided into two by a valve prolonging its anterior border. The disposition of the two orifices in the teleosts is variable: one of these, the anterior, is formed by a valve or carried on a small tube and closed to the exit of the water. The other posterior is freely opened, and closed to the entrance of the current. The nasal cavity is enveloped by a cartilaginous capsule (selachians), hollowed in the cartilaginous framework (ganoids), or lodged in bony interspaces (teleosts). In the latter case, there are large, squamous bones which circumscribe the interspaces.

The nasal organ of all water-breathing animals (with the exception of Amphioxus) is constituted by a fibrous sac in which the mucosa is exposed. This is folded and forms lamellae disposed in a radial way (cyclostomes, ganoids and numerous teleosts: barbel, trout, gurnard, etc.), or ranged on two sides of an axis (selachians, eel, etc.). The epithelium, formed of two orders of element, one epithelial, the other olfactory, is homogenous throughout the nasal cavity (cyclostomes, selachians, ganoids and numerous teleosts: eel, conger, carp, tench, trout, etc.) or shows small buds (olfactory) analogous to the taste buds and containing all the olfactory cells (belone, gurnard, pike and char, etc.).

II. The olfactory apparatus of air-breathing animals is disposed in a cavity opening externally and into the digestive tube. It occupies the entire extent of the cavity, uniformly (3), or it is localized to a particular region of this cavity of considerable extent (4), or is relatively restricted (5).

(3) The entire extent of the nasal cavity has the same structure; there is no distinction that can be made between the olfactory and respiratory regions (amphibian Urodela and Perennibrancha). The mucosa in the latter animals (Proteus, Axolotl) presents some folds comparable to the lamellae of fish. The group of Perennibrancha establishes the transition between groups I and II.

(4) In the nasal cavity, the olfactory region may be distinguished from the respiratory; the olfactory, characterized by thickness of the epithelium and the presence of sensory cells, covers a large extent of the walls of the cavity; it has no architectural peculiarity (Anura, Sauropsidia).

The other region, the respiratory, is subjected to a decided extension, as the nasal cavity becomes an important air passageway. This extension is effected by the formation of culs-de-sac in relation to the choanae (Anura) or by the appearance of a parietal ridge, a turbinal, which increases the surface of the mucosa (Sauropsidia).

(5) The nasal cavity constitutes a very important air passageway and the olfactory region is very much restricted, but its surface is enlarged by a false turbinal (crocodiles, birds) or by numerous ethmoid turbinals (mammals). This olfactory region is characterized by its sensory structure and its relations to the olfactory nerve. The respiratory region, much extended, is increased by the presence of turbinals and accessory cavities. It has an investment of cylindrical, ciliated epithelium and numerous glands. The external orifice opens at the level of the skin on the dorsal surface of the snout or beak (reptiles, birds, ornithorhyncus) or on a special ridge of the face, the external nose, variable in its disposition (mammals). This orifice is single in a large number of cetaceans and asymmetrical in the cetodonts; atrophy of one naris and secondary opening of the corresponding cavity into that of the side opposite

explain this abnormal disposition. The internal orifice, or choana, opens on the buccal roof (amphibians, saurians), in a furrow of the buccal roof which is common with that of the opposite side (ophidians), in the form of a long palatine fissure (birds) or into the pharyngeal cavity (mammals).

The olfactory apparatus is enriched by a specially differentiated region, detached from the nasal cavity and connected in function with gustatory appreciation, utilized especially for the selection of food; this is the organ of Jacobson. a simple longitudinal furrow opening into the choana (anurans), or a cylindrical canal in communication with the buccal cavity, either directly (sauropsidians) or through the intervention of the nasopalatine canal (mammals). This organ is wanting in the crocodiles, birds and man.

The nasal cavity is protected by a cartilaginous envelope in amphibians, reptiles and birds. The bony skeleton forms a very incomplete boundary of this region in the anurans, reptiles, and birds, while in the urodeles and in mammals the walls are very extended.

The submucosa is characterized in mammals by the presence of vascular tissue capable of becoming turgescent, like erectile tissue.

Embryology, I.—(1) In the cyclostomes, from the beginning of development, the olfactory outline is constituted by an epithelial mass placed between the dorsal ectoderm and the anterior extremity of the neural tube (Petromyzon embryos of 4 and 6 mm.). The parity of the olfactory organ is indicated by the duplexity of the olfactory nerve and the presence of a median lamella in Ammocoetes. It is by the enormous development of the buccal orifice and especially the extension of its superior border, that the nasal organ reaches back in contact with the nervous system. The development of the mesoderm on the lateral portions approximates the two outlines to one another and unites them at the level of the neuropore.

I (2) and II.—In all animals with a double nasal organ, it takes its origin from the ectoderm, which is thickened into a lateroventral zone placed below the inferoexternal angle of the neural tube. This outline becomes ventral (selachians) or dorsal in the course of evolution (bony fishes, amphibians, reptiles, birds, mammals).

All the layers of the ectoderm are employed in the development of the olfactory organ: the first proof is taken from the precocious differentiation of the superficial layer of the ectodermic thickening into sensory cells; the second from the presence, in the deep regions of the nasal walls of the amphibians, of pigmented cells which originally belonged to the external layer of the ectoderm.

The hollowing out of this thickening transforms it into a fossette; this, in the amphibians, grows directly into the surrounding mesenchyme; its ventral wall sends out a thick epithelial bud which reaches the buccal epithelium posteriorly. The nasal lumen penetrates into this bud and forms the inferior cul-de-sac upon the greater portion of its extent and the choana at the level of its posterior extremity. In reptiles, birds and mammals, the fossette is prolonged backward in the form of a furrow. The fusion of the surrounding mesodermic masses (nasal and maxillary buds) forms a ventral wall, closing thus the fossette and furrow for a considerable length (primitive palate) and leaving only two orifices, one anterior(external nasal orifice), the other posterior (primitive choana or palatal cleft). In mammals, this cleft is closed at the beginning by the bucco-nasal membrane, and opens only secondarily into the buccal cavity. This latter enters into the constitution of the definite nasal cavity at the period at which it forms the secondary palate. The epithelial budding of the external wall and the fissuration of these buds bound the region of the ridges which become the turbinals (reptiles, birds, mammals).

The very great extension of one of these fissures ends in the formation of the maxillary sinus.

The development of the ethmoid turbinals and their fusion behind separate from the nasal cavity a region which becomes the sphenoid sinus; the extension of the ethmoid anteriorly provokes the appearance of the frontal.

At a very early period of development, a furrow like evagination of the internal surface of the nasal cavity forms the beginning of the organ of Jacobson (reptiles, mammals, man); this region is the site of cellular differentiation from the time of its appearance.

The growth of the nasal cavity in its anterior portion (vestibular region) is effected by fissuration of a solid epithelial mass (epithelial button) which is quite long and is situated between the external orifice and the anterior extremity of the turbinals (reptiles, birds, mammals, man).

The glands appear late.

The skeleton is primarily cartilaginous. it surrounds the cavity and furnishes an axis for each turbinal. In the superior turbinal of birds, the cartilage of the external wall forms only a simple fold instead of an axial lamella.

The cartilaginous envelope persists in this state in amphibians, reptiles and birds and remains independent of the bony skeleton; in mammals, it is subjected to the phenomena of ossification and is united to the facial skeleton.

The date of appearance of the different elements of the nasal apparatus is indicated in the following table:

TABLE OF BEGINNING OF THE DIFFERENT ELEMENTS OF THE NASAL APPARATUS.

	Cyclostomes	Selachians	Teleosts	Amphibians	Reptiles	Birds	Mammals	Man
Olfactory Outline.	Petromyzon of 4 mm.	Pristiurus of 5 mm.	Salmon trout, 34th day of incubation.	Tadpoles of toad and frog of 4 mm.	—	Parrot of 5 mm.	Mole, 4 mm. Guinea-pig 5 mm. Sheep, 8 mm.	—
Sensory Cells.....	—	Pristiurus, 7 mm.	Salmon trout, 34th day of incubation.	Tadpoles of toad, 10 mm.	—	Parrot, 8.5 mm.	Mole, 5 mm. Sheep, 8 mm.	8 mm.
Primitive Palate..	0	0	0	0	—	Parrot, 6.5 mm.	Mole, 7 mm. Sheep, 10 mm.	8 mm.
Secondary Palate..	0	0	0	0	—	—	—	47 to 60 mm.
Turbinals.........	—	Mucous folds, Pristiurus, 12 mm.	Mucous folds, rainbow trout, one month.	0	Blindworm, 25 mm.	Parrot, 11 mm.	Mole, 9 mm. Sheep, 15 mm.	19 mm.
Sinuses...........	0	0	0	0	—	—	Maxillary sinus, Calf, 11 cm.	47 to 60 mm. (Maxillary sinus)
Organ of Jacobson.	0	0	0	Toad with 4 feet and long tail.	—	0	Mole, 6 mm. Sheep. 10 mm.	19 mm.
Olfactory Nerve...	Petromyzon, 3.5 mm.	13.5 mm.	—	Toad, 13 mm.	Blindworm, 25 mm.	—	—	—
Glands..........	0	0	0	Toad with 4 feet and long tail.	Blindworm, 7 cm.	Chicken, 8th day of incubation	Sheep, 13.5 cm	80 to 100 mm

0 Indicates absence of organ.

— Indicates no observation made by us.

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XLIV.

SURGICAL TREATMENT OF TUBERCULOSIS OF THE UPPER AIR PASSAGES AND THE EAR.

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No subject in medicine possesses a more extensive or interesting history than tuberculosis, nor can any disease boast of more attempts at solving the problem of its treatment with less permanent, definite and satisfactory results. Still out of the mass of suggestions for more or less radical lines of action, it cannot be denied that progress has been made and that many cases are cured, many more are improved and a large number is given an increased and comfortable longevity. This is true of tuberculosis generally, but it is particularly so of tuberculosis of the upper air passages. To go back more than a few years into the history of the treatment of this affection is only of literary interest. The only practical result which followed the enthusiastic advocacy of innumerable remedies and methods of treatment was an occasional valuable advancement. By the errors of overenthusiasm, however, we have profited to the extent of being better able to denitely and intelligently apply certain modes of treatment, and in no field of our science is this more marked than in the surgical treatment of tuberculosis of the throat, nose and ear.

It cannot be claimed that the extravagant hopes of the fathers of the operative management of tuberculosis of the upper air passages have been fully realized, but the twenty years which have passed since Krause,[1] 1885, and Heryng,[2] 1886, promulgated their views have unified to a great extent the views of laryngologists, and the pendulum is now swinging near a more rational plane. The name of Herman Krause is indissolubly associated with the lactic acid treatment of tuberculosis, and that of Heryng with operative measures. These two methods have, however, always been closely associated, and consequently the Krause-Heryng method covers more nearly the surgical treatment.

Included in this term, so far as the upper air passages are concerned are, first, deep incisions; second, curettage; third, excision; fourth, galvanic cautery; fifth, tracheotomy;

sixth, laryngectomy. So far as the ear is concerned, operative treatment includes the same measures that are applied to chronic suppurative processes of non-tuberculous origin. These surgical procedures have, however, certain limitations which are always largely controlled and modified by the character of the lesions, their nature, extent and complications, and also by their primary or secondary development. Thompson states that "we must look elsewhere at present than to surgical measures for a prospect of progress in the treatment of tuberculosis of the larynx. This progress is ready to hand in the making of an earlier diagnosis of local infection."[3] The early diagnosis, therefore, adds another extremely important limitation to the surgical management of these cases. This is true not only of the larynx, as Thompson announces, but it applies as well to the ear.

Tuberculosis of the Ear.—This may be considered as a form of chronic suppurative otitis media with possibilities of all the complications with which we are familiar. Its nature differs in that its attack is slow, insidious and attended at times by very extensive destruction, due in large measure to the lowered resistance of the tissues. All cases of chronic suppuration of the middle ear in tuberculous individuals must not be considered tuberculosis, but whether tubercle bacilli are found or not does influence the indications for surgical measures. The vast majority of suppurative processes in the middle ear occurring in tuberculous patients do not go on to destruction of bone; therefore, surgical measures have but limited usefulness. Politzer[4] advises operation for tuberculous diseases of the petrous bone when pulmonary tuberculosis develops in the course of a long standing suppuration of the middle ear, while he advises against operation when the disease of the bone comes on in the course of a well-established pulmonary lesion. Milligan[5] advises operation when the extent of the disease is not too great and the general condition of the patient not too hopeless. The objects to be obtained are the removal of all available foci of the disease and the establishment of efficient drainage. These two views should form a basis upon which to build our indications for treatment.

Given a patient whose general condition is fair, whose temperature and pulse do not indicate rapidly progressing disease, whose hygienic, sanitary and social surroundings are favorable and whose ear lesion consists in destruction of bone, an attempt should be made to remove it by surgical measures. The nature of the operation will depend upon the site and extent of the lesion. If ossiculectomy will suffice it should be performed, followed by careful curettage and the application of lactic acid and antiseptic irrigation. If the mastoid be involved, a radical operation is indicated. Under all circumstances the two important considerations to be borne in mind are the removal of diseased bone and the establishment of free drainage.

Tuberculosis of the Nose.--This is of rare occurrence. It is usually seen in the form of ulcerations or new growths, so called tuberculomata. When seen early, surgical measures are followed by surprisingly good results. Ulcerations should be thoroughly curetted and lactic acid freely applied. Tuberculomata should be removed by the cold wire or galvanic cautery snare. This should be followed by thorough curettment, after which lactic acid should be freely applied. The nose responds more satisfactorily to surgical treatment in these cases than any other portion of the upper air passages. This is due to the fact that tuberculosis of the nose is seen early, that the lesion is usually limited and that it occurs as a manifestation of the more chronic forms of the disease unattended by high temperature and rapid pulse.

Pharyngeal Tuberculosis.—As a rule, all the conditions which contraindicate surgical intervention in tuberculous processes exist when the pharynx becomes involved. The disease is a manifestation of a rapidly progressing, acute process. It is associated with high temperature and rapid emaciation. It accompanies the most asthenic form of tuberculosis. Its local manifestations are scattered and spread rapidly and widely. When we see a solitary circumscribed ulceration in any portion of the pharynx in a tuberculous individual, it is well to question its tuberculous character. In the writer's judgment, the curative value of any surgical procedure for tuberculosis of the pharynx is so limited that it may be practically discarded. As a palliative remedy, operative measures possess some virtue.

The particular forms of surgical intervention that are applicable are curettage and galvanic cautery. After thoroughly cleansing the ulcerated surface and applying 20 per cent cocain solution, the galvanic cautery or the curette may be freely used. The writer prefers to do as much at one sitting as possible. The after-effect may be rather severe for a few days, but not much more so if a large surface is operated upon than if the surface is limited. The relief to pain is usually sufficient to justify the procedure. The shock to the patient is moderate and is distinctly less than when frequent operations over small areas are performed. The rationale of surgical measures where only palliative results can be expected depends upon the histological research of Danzac,[6] who found that the pain in tuberculous ulcerations was due to a "proliferation of the terminations of the peripheral nervous filaments—a veritable neuroma of regeneration." By destroying this proliferation or nervous tumor, much of the sensitiveness is relieved.

Laryngeal Tuberculosis.—This is the most common complication of pulmonary tuberculosis, and in as much as primary lesions of the upper air passages are extremely rare, if they ever occur, laryngeal tuberculosis is the form that has more generally attracted our attention. It occurs early and late in the disease, is attended with symptoms barely noticeable, as well as of such severity that the laryngeal complication is the most important manifestation of the disease. When, therefore, Krause and Heryng advocated so strenuously and with such a good showing surgical treatment, this method was hailed with delight and applied heroically and with great radicalism. Time, however, has shown that like all other remedies, operative intervention in laryngeal tuberculosis has its usefulness, but also its abuses. Each form of surgical procedure has its particular advantage.

Deep Incisions.—This procedure is particularly useful when there exists pronounced edema or extensive, uniform, smooth infiltration. The value of incisions in edema is seen in marked shrinking of the swelling and relief in many instances, to difficult, not necessarily painful delugtition and to respiratory distress. In cases of uniform, pale, more or less firm infiltration, deep incisions are principally useful as an auxiliary measure to the thorough application of lactic acid. In this connection one might refer to the submucous injections of lactic acid, creosote and other preparations, as advocated by Major,[7] Chappell[8] and others. Such injections, however, are but mild imitations of deep incisions followed by friction with lactic acid.

Excision.—This is a true surgical manipulation and is an ideal method of operating upon tuberculous deposits. As such, its application is limited to those cases in which there is a certainty or a strong probability of completely removing the entire focus of disease. It is here, however, that we must face the most discouraging feature. The diagnosis is rarely made so early that a limited involvement of tissue, well circumscribed, manifests itself. The character of the lesion as well as its early recognition also offers an opportunity for this surgical measure. The true tuberculous tumor is frequently and fortunately among the earliest laryngeal manifestations.[9] It is more likely to be well localized and is readily extirpated. The infiltrative or hypertrophic tuberculous manifestation usually invades surrounding structures to such an extent that its extirpation would be a practical impossibility. Not infrequently, however, the epiglottis or a portion of the epiglottis is the principal laryngeal involvement. The tuberculous focus may be, in this instance, satisfactorily removed, the healing being often prompt and gratifying. However, one must be fairly certain that the tuberculous process is expending itself upon the epiglottis and not also upon contiguous structures, and too much stress cannot be laid upon the necessity of repeated and most careful laryngoscopic examination before an operation is undertaken. Even then it is in many instances absolutely impossible to determine the extent of the infiltration. Two specimens that I present herewith are good examples of two extremes. The first specimen is that of a well-defined circumscribed tumor which was located in the posterior commissure. Its removal was easily accomplished, and so far as the larynx is concerned the patient had no further trouble. The section as shown by the microscope confirmed the diagnosis showing the presence of numerous tubercle bacilli in the tissue. The second specimen shows extensive tuberculous infiltration and ulceration of the epiglottis, aryepiglottic folds, the arytenoids, the interior of the larynx and the subglottic region. A section taken from the trachea shows abundant tubercle bacilli in the tissue. This illustrates the difficulty and, in fact, the impossibility of determining the extent of the lesion microscopically. One would, of course, not advise the extirpation of so extensive a lesion as is seen here, but the conclusion is forced upon us that even though the infection involve a moderate portion of the larynx, the naked eye cannot detect its extent when we consider how far in advance of the apparent lesion the infection in this case was found.

Curettment.—This procedure is probably the most frequently applicable of all surgical measures. It is indicated in ulcerations and soft excrescences. Tuberculous ulcerations may be classified into acute or active, and chronic or sluggish ulcerations. The acute ulcerations are usually associated with marked edema, extensive involvement of surrounding structures, high temperature and other manifestations of great activity in the tuberculous process. Curettage is here contraindicated. On the other hand, the form of ulceration which is sluggish, localized, attended with no marked edema or constitutional evidences of rapidly progressing disease, respond promptly to this surgical intervention. After thoroughly curetting, lactic acid or Lake's formula, of formalin, lactic acid, carbolic acid and glycerin, should be thoroughly rubbed into the parts. Healthy granulations are soon seen and the cicatrization of these ulcerations is a common result. Other ulcerations may develop and may be treated likewise. Repeated and extensive operations of this kind may thus be performed as various new ulcerations develop. Frequent cures have been reported, notwithstanding the involvement of much of the laryngeal structure. The salvation of this class is in the fact that the extensive involvement is not found at one time, but is developed progressively, each new development being met by the same radical surgical measure.[10] Thoroughness in this manipulation is essential. The curette should be strong, sharp and at the same time so delicately constructed that it may be applied to any portion of the larynx with ease. To meet these requirements I have for years used the accompanying instruments with much satisfaction. The soft papillomatous excrescences so frequently seen in laryngeal tuberculosis are readily removed by the curette. If, however, they are of a large size, Krause's laryngeal forceps may precede the curettage.

Galvano-Cautery.—This is an extremely useful method of bringing about cicatrization of small, easily accessible tuberculous ulcerations. It should not be used indiscriminately, nor can it be as extensively applied as the curette. The serious reaction following its use need only be feared where it is too vigorously and too extensively used.

Tracheotomy.—Notwithstanding an occasional, sporadic, enthusiastic advocacy of tracheotomy for the cure of tuberculosis of the larynx, it has never been accepted by the majority of laryngologists. Schmidt, I believe, still advocates placing the larynx at rest by this method, and its virtue was well demonstrated in a case of most extensive tuberculous disease of the larynx reported by McIntyre. It would seem that this operation might be justified upon rational grounds, but the dangers from the usual complications following tracheotomy, such as increased bronchitis and pulmonary irritation, must always be sufficient to deter one from accepting tracheotomy as a routine measure. It may possibly be of more value in children, as recently suggested by Finder.[11] His recommendation is based upon the difficulty with which intralaryngeal manipulation may be carried out in children. A number of years ago I tracheotomized a child for multiple papillomata of the larynx. The tracheotomy tube was retained for a considerable period of time during which the papillomata were being gradually removed. The child developed tuberculosis and died within a very short time thereafter. It always seemed to me that the tracheal opening favored pulmonary infection and assisted its rapid progress.

Laryngectomy.—This operation, partial or complete, will probably always be considered inadvisable in tuberculosis. So dangerous a procedure can only be considered when the disease is definitely localized. At such a time intralaryngeal methods are of quite as much avail and are not attended with the same dangerous possibilities.

SUMMARY.

First. The views of the majority of laryngologists regarding the surgical treatment of tuberculosis of the upper air passages have been unified in the past twenty years.

Second. Surgical measures are controlled by the character of the lesions, their nature, their extent and other complications, whether primary or secondary, and by the limitations placed upon the possibility of early diagnosis.

Third. All cases of chronic suppuration of the middle ear in tuberculous individuals are not necessarily tuberculous.

Fourth. The objects of surgical measures in tuberculosis of the ear are the removal of all available foci of disease, the removal of diseased bone and the establishment of free drainage.

Fifth. Tuberculosis of the nose responds readily to surgical treatment, the methods used being curettment and excision by cold wire or galvanic cautery snare.

Sixth. Pharyngeal tuberculosis is a manifestation of the most asthenic form of the disease, presenting all conditions which contraindicate surgical intervention.

Seventh. Operative measures in pharyngeal tuberculosis are only of palliative value.

Eighth. In laryngeal tuberculosis, deep incisions are valuable in edema and in uniform, firm infiltration, their usefulness being increased by rubbing with lactic acid.

Ninth. Excision of tuberculous deposits is limited to those cases in which there is a certainty or a strong probability of completely removing the entire focus of disease.

Tenth. The extent of the involvement is often greater than can be determined by laryngoscopic or microscopic examination.

Eleventh. Curettment is valuable in ulcerations and soft excrescences. The character of the ulceration modifying, however, its applicability.

Twelfth. Repeated and extensive operations may be performed provided the lesions develop progressively.

Thirteenth. Galvanic cautery is useful in small, easily accessible tuberculous ulcerations.

Fourteenth. Tracheotomy may prove of value in children and is always indicated for the relief of dyspnea.

Fifteenth. Laryngectomy is probably never indicated.

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ABSTRACTS FROM CURRENT OTOLOGIC, RHINOLOGIC AND LARYNGOLOGIC LITERATURE.

Examination of the Stuttering Among the School Children in the Netherlands.

DR. G. H. MULDER reports an examination made by the committee of the Netherlands Laryngological, Rhinological and Otological Society (*Tydschr. v. Geneesk.*, April 28, 1906). Twelve members of the society participated. The principals of the schools filled in blanks with 13 questions. Of 68,914 children, 745 were stutterers, that is 1 per cent; of the 36,260 boys, 599 were stutterers, that is 1.64 per cent; of the 32,654 girls there were 146 or 0.44 per cent. Of the total of the stutterers, 80.4 per cent were boys and 19.6 per cent were girls. Mulder considers that this difference of the sexes favors a hereditary explanation, as is found in hemophilia and color-blindness. The smaller number of the stuttering girls argues against psychical infection, as the female sex possesses more the gift of imitation willingly or unwillingly. The age is given in 526 of the 745 stutterers. The only conclusion in regard to the grade in which these children were is that we do not find a large increase in frequency during the school years. Stuttering began in most of the cases before the sixth year; of 446 stutterers, 187 began before they were 3 years old and 108 before they reached the age of 6. This also in favor of a hereditary tendency or congenital defect, and seems to presuppose a localized defect in the central nervous system or in some center or in the mutual connection of the centers. The question "do more stutter in the family" was answered very differently and insufficiently, still in 216 of the 526 cases the answer was positive. The general conditions did not give an opportunity for specific observations; only one examiner found 53 of his 88 cases "scrofulous." Of the 523 children examined, 221 suffered from a restricted nasal breathing, through deviation or thickening of the septum, or adenoids (the large majority, some 40 per cent), or through enlarged tonsils, or through combinations of these.

Three degrees are distinguished: 1. Those in which the defect is very troublesome and is constantly present, so that these children can do no errands (90 of the 407 stuttering boys=22 per cent; 12 of the 88 girls=13.5 per cent).

2. Moderate, in which the defect is only now and then very strong, but generally little troublesome (147 boys=36.5 per cent; 27 girls=31 per cent). 3. Slight, in which there is little or no trouble (170 boys=41.5 per cent 49 girls=55.5 per cent). Boys and girls combined, 102=22.6 per cent belong to the first group, 174=35 per cent to the second, and 219=44.4 per cent to the third. Among the second group, many will be found who will suffer in the school or later, so that it is no exaggeration to state that one-fourth or perhaps one-third of the total number of stutterers will need help. In the family of at least 40 per cent of the stuttering children two or more were found; these were mainly brothers or sisters, but in many cases the father or mother as well. The percentage of children who have stutterers in their family is still much larger. In the large majority, a distinct nervous predisposition can be demonstrated. On account of this and other mentioned facts, stuttering can be considered due to a hereditary predisposition. The so-called accidental causes have a subordinate significance. A high percentage of backward children is found among stutterers. Although a general retardation of the intellectual development could not be stated, still in stutterers, more than among the entire school population, children were found who are two or more classes behind.

The number of cases is not sufficient to show a strong connection between stuttering and left-handedness; some facts, however, warrant a later investigation.

Blaauw.

The Treatment of Hay-Fever.

Prof. W. Koster (*Tydschr. v. Geneesk.,* May 19, 1906) had little success with Dunbar's serum. Koster is more and more convinced that contamination with pollen of the graminae is still the direct, but not the real, cause of this odd affection. It must be concluded that there is some change in the individual when he has been free until his thirty-fifth year and then acquires these symptoms after contact with pollen, which disappear after removal from this contact. His attention became directed to the chronic changes of the mucous membranes which are found with so many sufferers of hay fever, the so-called "dry" inflammations of the mucous membranes of the eye, nose and throat. Contact with pollen produces in healthy people increased production of mucus; the mucus partly envelops the pollen with an impenetrable layer and, as far as it covers the membrane with an invisible layer, makes it impossible for the pollen to have any influence on the layer of nerves and blood vessels. This reaction does not take place in the patient with "dry" inflammation; his mucous membranes are or become duly moist but not mucous. The consequence is that the pollen may exhibit its irritating action. Koster recommends the potassium chlorate, which has a soothing action in chronic pharyngitis, as it produces a clear, somewhat sweet mucus. He uses it in the following way: As soon as the irritative symptoms commence or should begin, that is about the middle of May, one must gargle the throat well with a 3 per cent solution, then irrigate the nose by pouring this same solution into it with a teaspoon, and when the fluid is snuffed up well, spit it out, and then the eyes are treated with an eye bath. This should be repeated three times a day. During the treatment smoking is not allowed, and it is not advisable to use stimulating drinks, especially alcoholic. The patient should keep away from dust and should walk very little in the country; when the nose, throat or eyes itch, menthol should be snuffed up, till the irritation has disappeared, also after an attack of sneezing. One has to be careful in not "catching cold," as every affection of the mucous membranes operates in favor of the hay fever. Koster uses sometimes insufflations of 100 to 200 mgr. of potassium chlorate powder in the nasopharyngeal cavity. It may irritate the mucous membrane of the nose and throat at first, but only for a few minutes, and the next time the patient hardly feels anything. The patients must be carefully instructed not to swallow it, and care should be taken that not too much is resorbed, as otherwise nephritis and renal hemorrhage may follow. Children should learn with a 1 per cent solution of sodium chlorid. The seashore is excellent when there is a sea breeze. The trouble is increased by sunshine and land breeze. Hay fever can be combated in three ways:

1. By preventing contact of the pollen of the graminae (and most probably of other pollen) with the sensitive person.

2. By making the person immune with serum, as described by Dunbar.

3. By treatment of those mucous membranes on which the pollen acts, so that they have their normal means of defense.

Blaauw.

The Course of the Sigmoid Sinus in the Child's Skull.

RUDLOFF, Wiesbaden (*Archives of Otology,* Vol. XXXV., No. 2). Macewen's guide for determining the course of the transverse sinus in the adult is by connecting the deepest part of the parietal incisure of the temporal bone with the mastoid; this line describes the middle part of the venous sinus, sometimes its posterior part on the left side, frequently its anterior margin.

The author found in the child the anterior margin of the sigmoid sinus is situated at a varying distance posterior to Macewen's line.

I. At a level of the root of the zygomatic process, the distance is:

1. In the new-born, 6 mm.
2. In a child 1 year of age, 6 mm.
3. In a child between 2 and 3, 10 mm.
4. In a child of 6, 3 mm.
5. In a child between 9 and 10, 7 mm.

II. At the level of the parieto-mastoid suture, the distance is still greater.

1. In the new-born, 7 mm.
2. In a child 1 year of age, 10 mm.
3. In a child between 2 and 3, 17 mm.
4. In a child of 6, 6 mm.
5. In a child between 9 and 10, 16 mm.

The distance is greater, the broader the mastoid process. In the new-born the groove in the temporal bone is so shallow as to be hardly recognizable. It grows, however, and at the seventh year resembles a half-cylindric groove, while the mastoid process extends somewhat backward. As the groove becomes deeper, the sinus travels forward so that its anterior margin in the course of years gradually approaches and passes beyond Macewen's line. *Campbell.*

A Congenital Fibrolipoma of the Palatal Tonsil.

ZOLKI, Strassburg (*Archives of Otology,* Vol. XXXV., No. 2). Benign tumors of the tonsils have rarely been observed.

The mother state that, in a child of 7 years, she observed a tumor in the throat shortly after birth. For the past four years there has been a disturbance in swallowing. On examination, a large smooth, pale red tumor, 30 mm. in length and 11 mm. in breadth and thickness, is seen attached by a narrow pedicle to the upper part of the left tonsil.

The tumor consists of connective tissue traversed by numerous blood vessels and is covered by several layers of pavement epithelium, which become horny in the superficial layers. The tumor's most unusual feature is an area of lymphatic tissue, 5 mm. in diameter, at a point farthest away from the tonsil, which contains follicles—in fact, looks like a piece of tonsil. *Campbell.*

Otitis Interna Sinistra Hemorrhagica.
Vicarious Menstruation.

Amberg, Detroit (*Archives of Otology,* Vol. XXXV., No. 2). A woman, aged 33 years, in whose family there is no deafness and who had had no prior trouble with her ears, on an August afternoon took a very hot bath, in which she remained 20 minutes. Afterwards, stooping forward and throwing her hair over her head to comb it, she became so dizzy and nauseated on again assuming the erect position that she had to lie down for one and one-half hours.

She had just gotten over her normal, scant, three-day menstruation. On the following day, she noticed a noise in the left ear like escaping steam. The nausea persisted for three days. The dizziness lasted two and one-half months.

Hearing by watch—right ear, $^{72}/_{100}$;
left ear, $^{1}/_{200}$.

Hearing by low tuning forks is present in both ears.

Hearing by C_2 fork	Right ear	Air 7 seconds.	Air 5 seconds.
	Left ear	Bone 4 seconds.	Bone 4 seconds.

C_5 is heard by both ears, but not so clearly by the left.

Weber localized to the right.

Both Mti are retracted and light reflexes absent.

Gellé's test is positive for right ear; negative for the left.

Urine examination negative.

Blood shows some anemia.

The author's diagnosis was a left labyrinthine hemorrhage, of the nature of a vicarious menstruation. *Campbell.*

Circulatory Disturbances Following Ligation of the Internal Jugular Vein in Sinus Thrombosis with Report of a Case.

EAGLETON, Newark, N. J. (*Archives of Otology,* Vol. XXXV., No. 2). A boy aged 9 years, who, since an attack of scarlet fever five years ago, has had intermittent left otitis media purulenta.

During an attack of malaria, when blood examination showed numerous plasmodia malariae, the ear discharge began and disappeared.

The mastoid was opened and found absolutely normal. The sinus was exposed and, well down towards the bulb, it was blackened with a small opening, low down, through which a drop of pus oozed.

The jugular was ligated and this was immediately followed by a profuse flow of blood from the upper wound, soft parts and bone. Firm tamponage was necessary to control this hemorrhage.

On the following day there was marked double optic neuritis although none was present one-half hour prior to operation restlessness and chilly sensation. A general septic condition developed, the whole ligated jugular area was excised, the upper portion being bathed in pus, while the portion below the ligature was filled with a firmly organized, non-septic clot, which extended downwards behind the clavicle.

Great difficulty was experienced in changing dressings, because of the hemorrhage which succeeded any disturbance of the firm packing. Lumbar puncture was twice done and the cerebellum twice explored with negative results. There formed a hernia cerebri; there was irregular, projectile vomiting, vertigo, loss of co-ordination of the left arm and leg, deviation of the tongue, but no loss of flesh; this latter argued against the existence of an abscess, as in the experience of the author, cerebellar abscess is invariably associated with a rapid loss of flesh.

Ten weeks after the primary operation, death supervened.

On autopsy, the left lateral, the torcular, the inner one-fourth of the right and nearly the whole of the superior longitudinal sinuses were all thrombosed.

The hernia cerebri involved nearly the whole of the left lateral lobe of the cerebellum, and extending from it was an area of softening involving the left lateral portion of the pons. The author ends his report by reviewing the literature where jugular ligation had resulted disastrously. *Campbell.*

What Cases of Chronic Purulent Otitis Require the Radical Operation?

KNAPP, New York (*Archives of Otology,* Vol. XXXV., No. 2). The trend is to greater conservatism. Ballance is the only one who still states that all cases of chronic purulent discharge from the ear should be treated by the complete operation.

Cases of chronic purulent otitis where intracranial complications, stenosis of the canal and acute mastoiditis are present are left out of consideration, because the wisdom of operating under these conditions is self-evident.

An excellent classification is that adopted by the Berlin Ear Clinic, where the cases are divided into two groups: dangerous and non-dangerous. In the former the bone is affected, especially in the attic and antrum. In the latter, the inflammation is more localized to the mucous membrane of the tympanum, a region from which intracranial complications rarely ensue. In disease of the tympanic walls proper, little can be accomplished by operation, and necrosis of the promontory wall had better be left alone.

The operation is urgent when symptoms of headache, nausea and vertigo are associated with, and in relation to, chronic purulent otitis where the bone is found affected, and this is indicated by the characteristics of the discharge and its fetor, and by the otoscopic picture. There is a total defect of the Mt. or the perforation is marginal, the adjoining portion of the annulus eroded, the perforation being situated next to the superior or posterior wall, i. e., contiguous to the attic and antrum. The presence of cholesteatoma is an urgent indication for operation, unless the opening of the accessory cavities into the middle ear is large and there apparently is no tendency to retention.

Operation is indicated when the signs of bone involvement continue after conservative treatment has been followed for a reasonable length of time, and the odor in the discharge persists. If drainage is good, there is no urgency for operation, and one should hesitate where there is defective hearing

The Leucocyte Count in Inflammatory Diseases of the Ear and of the Temporal Bone, and in the Intracranial Complications.

SUCKSTORFF, Hanover, Germany (*Archives of Otology*, Vol. XXXV., No. 2). The leucocyte count in children under 10 years of age is higher than in those who are older.

In serous otitis media, both in adults and children, there is no increased leucocytosis.

In purulent otitis media in young children, the average leucocyte count was 20,150, but we must remember that children react with an increased number of leucocytes to suppurations and other diseases.

In six cases of chronic purulent otitis media, there was no increase of leucocytes.

In mastoiditis without intracranial complications, there is a slight increase in the leucocytes, more marked in children than in adults.

The reason why the leucocyte count is not markedly increased in mastoiditis is probably because the abscess in the mastoid process is surrounded on all sides by bone. The same is true in the case of thick-walled brain abscess, but when this membrane is destroyed at operation, the body reacts by increase of leucocytes.

In meningitis, Rieder believes that the absence of leucocytosis confirms the diagnosis of its being tubercular. Türk found that in purulent cerebro-spinal meningitis and in secondary purulent meningitis, leucocytosis was present.

In two cases of the author's, he was unable to confirm these observations. *Campbell.*

Incorrect Deductions from Experiments with Tuning-forks on the Function of the So-called Sound-conducting Apparatus.

ZIMMERMAN, Dresden (*Archives of Otology*, Vol. XXXV, No. 3). The paper is a criticism of that of Bezold, an abstract of which appears in this number. The author claims that though Bezold's observations are correct his deductions are erroneous.

In testing sound waves of the lower scale, he used tuning forks, which the normal ear hears at a distance of a few cm. away from the meatus, when he should have employed a drum or organ pipe.

The author has recently examined two patients who had been radically operated upon, where the ossicular chain was wanting and the region of the oral window was covered by a dense membrane. One of these patients was able to hear with both ears. The other was able to hear with one ear the A tuning fork distinctly by air conduction. The significance of the ossicular chain is not, therefore, that of a sound conductor for the deep tones, but it acts as an accommodative apparatus, which is necessary. *Campbell.*

Symptoms and Treatment of Sinus and Jugular Thrombosis with the Report of Five Cases.

KENNON, Norfolk, Va. (*Archives of Otology,* Vol. XXXV, No. 3). The temperature in this affection is that peculiar to pus absorption; if typical, it is characterized by a sudden rise followed by an equally sudden fall. In several instances of the observed cases, there was a gradual rise followed by a gradual fall, extending over a period of from 6 to 12 hours.

Chill may vary from a pronounced rigor to merely chilly sensations of the extremities. It occurred only once in the five cases reported.

Pulse is usually rapid; it rarely gets back to normal even though the temperature does so.

Optic neuritis is rare; it is more frequent in cases of epidural abscess than in sinus thrombosis.

The presence or absence of pulsation is of no significance in determining a thrombus; granulations on the sinus wall argues against its involvement, for this is a barrier which nature has thrown out between the infective process and the blood current. The aid to diagnosis by palpation is in many cases most misleading.

Rapidity of operation is of great importance. The patients, very frequently, are exhausted by disease and bear the anesthetic badly. If the temperature be indicative of sinus involvement, open it at the time of the mastoid operation. Should the thrombus be situated in the bulb, either primarily or secondarily, at once expose and resect the jugular from the facial downward, while the upper end of the vein is brought out of the upper angle of the wound. The neck wound is left open and heals by granulation, the edges being approximated by adhesive strips. *Campbell.*

The Functional Examination of the Hearing with Tuning-forks in Monolateral Deafness, with Deductions on Bone Conduction and the Function of the Sound-conducting Apparatus.

Bezold, Munich (*Archives of Otology,* Vol. XXXV, No. 3). In an examination of four patients with a labyrinth defect on one side, while the other side was healthy, and in three with a labyrinth defect on one side with the other side deaf, by means of the continuous tone series, the author was able to show that the supposed hearing of the ear without a labyrinth is nothing but the reflex of the hearing of the other healthy or partly defective ear, brought about by the impossibility of excluding the healthy ear during the examination.

This reflex is situated exclusively in the upper part of the tone series, and extends from the marked octave to the upper hearing limit of the normal ear. The lowest tone limit, which is heard for a moment only by the ear without a labyrinth is situated between a^1 and a on the Bezold-Edelmann tone series.

To demonstrate one-sided deafness, if one finds that the middle tone of the scale a^1 is not perceived or only slight so, and at the same time the lowest part of the scale which is examined with a few deep forks without overtones is found wanting, then we may assume deafness: if in the case of middle-ear suppurations, the hearing for some of these tuning-forks was previously good, then in case of their defect it can be assumed that the suppuration has extended to the labyrinth.

In the examination of the four cases without a labyrinth but with the other ear intact, the tuning forks of the entitre scale up to a^1 were not perceived even when the tuning forks were brought in direct proximity to the ear without a labyrinth.

As regards the upper half of the scale, the perception takes place through the Mt. and the sound-conducting chain, as the auditory canal on the hearing side cannot be closed sufficiently tight in order to exclude the sound waves of the upper tones. As to the importance of the sound-conducting apparatus for the transmission of the lower part of the scale, we know that without this apparatus hearing by air conduction is impossible up to the treble octave. *Campbell.*

Two Cases of Grave Complication of Purulent Ear Disease Operated Upon and Reported.

Barr, Glasgow (*Archives of Otology,* Vol. XXXV, No. 3).
1. A fatal case of septic thrombosis of the lateral sinus, sec-

ondary to chronic otitis media purulent a in the left ear, and complicated with septic infarctions in the right lung.

A little girl, aged 7, had a copious fetid discharge from the left ear lasting one year. Prior to admission, she had many severe rigors, with oscillations of temperature from normal to 104° F. She complained of frontal headache, pain in the left side of the neck. Moist rales and tubular breathing was noted about the inferior angle of the right scapula.

On the radical mastoid operation being done, the sigmoid sinus was exposed and found converted into a yellowish sloughy-looking mass, surrounded by and partly filled with pus. The bulb contained a solid thrombus. The sinus was opened and cleared of thrombi but the pulmonary symptoms continued to increase.

On post mortem examination, the septic infarcts in the right lung showed the presence of pneumococci, streptococci and an unrecognized large bacillus.

2. A case of otitic extradural abscess, associated with paralysis of the sixth cranial nerve and double optic neuritis; operation and recovery.

A boy, aged 17, with purulent right middle-ear disease for 16 months, came to the hospital on account of headache, diplopia, paralysis of the external rectus and double optic neuritis.

On radical mastoid operation being done, cholesteatomatous masses were cleared out from antrum, aditus and attic of tympanum.

The sinus wall was covered with granulation tissue and pus, but as there were no signs of general septic infection it was not opened. The sixth nerve paralysis gradually passed off after operation but the optic neuritis was progressive; vision, however, so far is unimpaired. *Campbell.*

Infective Sinus Thrombosis, the Varieties of General Infection and Treatment.

ARNOLD KNAPP, New York (*Archives of Otology,* Vol. XXXV, No. 3). One distinguishes two forms of wound infection from pyogenic organisms. First, the form characterized by metastases, with interrupted, transient infection of the general circulation—pyaemia; and second, the form without metastases, with continuous toxic and bacterial infection of the general circulation.

The first form usually is produced by staphylococci, streptococci, rarely pneumococci, while in the second the streptococcus is most frequently found.

Theoretically, one may speak of a bacterial general infection (bacteremia) or of a toxic general infection (toxemia) according as the one or the other factor predominates. In the bacterial general infection, the bacteria increase in the blood (septicemia). In the toxic form, as in tetanus, the toxins develop at the site of infection and spread over the body.

If at operation one finds periphlebitis of the sigmoid sinus, which has caused no symptoms or remittent fever and chills, one is justified in not attacking the sinus, but awaiting the outcome of the mastoid operation.

If, however, the sinus shows changes in consistency and color suggestive of thrombosis, with the signs of phlebitis, and the symptoms point to a general infection, the sinus must be explored, after being laid bare from the upper knee to near the bulb. If the proximal end of the thrombus is near the bulb and is disintegrated, or where the general infction is severe even though the proximal end looks healthy, the jugular vein should first be ligated at a point above the facial vein.

If the sinus wall be affected (phlebitis), a parietal clot is presumably present. In such a case, treatment varies according to the gravity of the systemic infection.

Primary bulb thrombosis can usually only be diagnosticated by exclusion in the presence of systemic infection, when the sigmoid and other accessible sinuses seem normal and contain fluid blood. *Campbell.*

On Post-operative Pyocyaneus Perichondritis of the Auricle.

TATSUSABURO SARAI, Japan (*Archives of Otology,* Vol. XXXV, No. 2). One of the most unpleasant complications of post-operative ear cases is perichondritis caused by the bacillus pyocyaneus. This obstinate, painful inflammation frequently leads to ugly thickening or deformity of the auricle.

The author's case was that of an anemic girl of 17, upon whom a radical mastoid operation had been performed. Three weeks later the presence of the bacillus pyocyaneus was suspected from the color and the odor of the pus. The dressing of the wound cavity was changed from moist to dry, but before introducing the dry packing a pledget of gauze saturated in

2 per cent silver-nitrate was introduced into the ear for 10 minutes. This is a procedure which has been extremely serviceable in similar cases in the Rostock Ear Clinic.

A few days after the pyocyaneus had been observed, the auricle began to swell, with darting pains and a slight rise of temperature. In a few days, the cavity and cymba conchae were obliterated by the swelling and the inflammation extended to the anterior part of the helix. There was no further extension of inflammation, but two weeks later fluctuation was found in the cavity of the concha. This point was incised and thin flocculent pus escaped. This pus when examined was found to contain the bacillus pyocyaneus in pure culture.

No cartilage was thrown off but a decided thickening of the cavity and cymba concha remained.

Campbell.

Prof. O Tränner (Berlin)

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XLV.

WIDMUNG DER AMERIKANISCHEN FESTSCHRIFT AN DEN HERRN GEHEIMEN MEDICINALRATH, PROFESSOR DR. B. FRAENKEL,

VON DR. OTTO FREER.

HOCHVEREHRTER MEISTER:

In dieser Sammelschrift begrüssen die Hals- und Nasenärtze der Vereinigten Staaten Sie als Führer in unserer edlen Wissentschaft, voll des Dankes für das Grosse das Sie als Forscher und Lehrer geleistet haben. Doch nicht allein dieses würdigen wir in Ihnen sondern wir erkennen auch mit Begeisterung den veredelnden Einfluss Ihres Strebens auf das Gedeihen der Laryngologie und Rhinologie an, denn das Beispiel ernster, streng wissentschaftlicher Arbeit das Sie den laryngologischen Schriftstellern der Welt gegeben haben, hat sie angespornt ähnlich Gediegenes zu schaffen und gleichsam als ob Sie ihnen prüfend zur Seite ständen, Halbheit und Oberflächlichkeit in ihrem Thun und Denken zu vermeiden. Ihr Archiv, eine

Schatzkammer für das Vorzüglichste in unserem Fache und der Ausdruck Ihres nur das Beste erwählenden Wesens, hat Sie uns Allen nahe gebracht, so dass auch diejenigen von uns welche nicht des Glück hatten Ihnen zu begegnen dennoch das Gefühl Ihrer freundlich ermahnenden und ermuthigenden Gegenwart im Geiste haben. Auf solche Weise arbeiten Sie nicht allein mit eigenem Denken sondern Sie leiten den Gedankengang und die Arbeitsweise vieler Jünger in allen Ländern und begeistern sie ihre besten Kräfte der Forschung zu widmen. Lange nach dem wir Alle von der Erde verschwunden sein werden wird Ihr Archiv, welches auf alle Zeit Ihren Namen tragen sollte, ein immer wachsender Schatz für die Nachwelt sein. Sein hochwissentschaftlicher Standpunkt hat nicht wenig dazu beigetragen die Laryngologie zum selstständigen Fache emporzuheben und sie davor zu bewahren ein blosses Anhängsel der Otologie oder gar der Ophthalmo-Otologie zu sein. Es ist aber noch viel zu thun um für die Hals und Nasenwissentschaft die ihr gebührende Würdigung zu erlangen und mögen Ihnen, Herr Geheimrath, noch viele Jahre gegeben werden, als unser leitender Geist, der Laryngologie und Rhinologie Gleichberechtigung neben ihren stolzen Schwestern in der Medizin zu verschaffen.

XLVI.

BERNHARD FRAENKEL — WHAT HE HAS DONE FOR RHINO-LARYNGOLOGY.

By W. Freudenthal, M. D.,

NEW YORK.

Early in June, when the writer prepared for a long journey to Arizona, New Mexico, etc., a prominent German physician invited him to dinner on board his steamship — a dinner which he gave in response to many courtesies received from American colleagues. When the writer declined on account of his contemplated journey to Arizona the next day, the Doctor jokingly remarked, "O, you mean that mythical land where the 'kicker' grows."

I do not need to assure my readers that Arizona is not mythical, but real; nor was my trip a myth, but a fact. After I had left New York it was decided to celebrate, in this country, the seventieth birthday of Professor Bernhard Fraenkel by a special number of the Annals dedicated to him. Hence, I have prepared my contribution rather in a hasty way. Part of it was written while camping at an altitude of about ten thousand feet on the bank of the beautiful Ruidoso River, in New Mexico, nearly three thousand miles away from my home. The rest was completed after my return to New York with the aid of some data kindly furnished to me by Dr. A. Alexander of Berlin. The shortcomings of an article written under such circumstances are naturally very great, and in this instance they are much to be regretted, in view of the high esteem which I hold for my distinguished friend and teacher, Professor Fraenkel. If the time had not been so very limited, perhaps something better would have been presented.

Bernhard Fraenkel was born on November 17th, 1836, at Elberfeld, in Rhenish Prussia. He received his preliminary education at the "Gymnasium" of that place, and went in 1855 to the University of Würzburg to pursue his medical studies, and a year later to Berlin, where he has remained since. In 1859 he was graduated at Berlin, his thesis being on perityphlitis, dedicated to the well-known ophthalmogist, Carl Pagenstecher, of Elberfeld, to whom he felt much indebted.

Through Pagenstecher he became acquainted with Professor Virchow, in whose pathologic institute he received a great impetus for scientific research. He became especially acquainted with Virchow's assistant, Professor Julius Cohnheim. It is undoubtedly due to this early training in the microscopic field that Fraenkel later on did such excellent work on the normal and pathologic histology of the larynx.

Together with Cohnheim he studied different phases of tuberculosis as early as 1868-69, evidence of which is to be found in his paper published in the *Berliner klin. Woch.,* No. 1, 1872, entitled, "Further Observations on Tuberculosis of the Choroidea." Among Fraenkel's other teachers were such men as Koelliker, Johannes Müller, Virchow, Langenbeck, Traube, du Bois Reymond, Gräfe and Henoch.

In 1871 Fraenkel took part in the Franco-Prussian war, and upon his return he established himself as "Privat Dozent" at the University of Berlin in the Department of Rhinolaryngology, and worked there in company with George Lewin, Tobold and Waldenburg. As the result of Czermak-Türck's teachings with the laryngeal mirror in Austria, as well as Voltolini's first observations in this field in Germany and Victor von Bruns' first successful removal of a tumor from the larynx per vias naturales, he was led to devote his time principally to laryngology. Still, he had started as a general practitioner, and remained one for quite some time. I believe even now he still has some general practice.

In 1873, he was made Visiting Chief of the Internal Division of the Augusta Hospital, a position now held by no less a man than Professor Ewald of Berlin. Soon, however, he resigned this position and devoted himself exclusively to work in laryngology in a private clinic which he established. For many years this dispensary was maintained solely by him in his private residence in a fashionable neighborhood near Unter den Linden in Berlin, at a great expenditure of time and money. It is a source of great pleasure to me to recollect the many pleasant instructive hours I spent there under him. Finally, at his urgent and continued request, the government established a university dispensary, and when it was opened in 1887 Fraenkel was made its director. Only a few years ago, May 2nd, 1901, a clinic with a large number of beds was opened at the Charité Hospital.

Thus he was enabled to give up his private clinic after having obtained governmental recognition of the fact that laryngology was entitled to the same privileges as other branches of medicine which had previously been established. In spite of this, Fraenkel, who in 1887, had received a title of Professor, was later appointed extraordinary professor at the University of Berlin. Why he was not, like the professor of ophthalmology, made an ordinary professor at that university, I do not know. At least, I am sure we all believe that laryngology is of equal importance with ophthalmology. Still, Fraenkel had every reason to congratulate himself on his achievement so far, and no doubt his successor will find it easier to secure for laryngology the full recognition to which it is entitled. At any rate, Fraenkel was the first laryngologist to receive the extraordinary professorship in Germany.

Fraenkel was married happily until 1888, when his wife died of cerebro-spinal meningitis, which she contracted while visiting one of her servants at the hospital.

It is difficult to do justice to all that Fraenkel has achieved in laryngology. I shall, therefore, limit myself to only the most important features of his life work. Probably all of us have read his work on diseases of the nose and larynx, published early in the seventies in *von Ziemssen's Handbook*. In this book are described a great many instruments originated by him which are still used—for example, his nasal speculum and tongue depressor. To mention one point only, I will say that in the chapter on ozena Fraenkel describes this condition so accurately and carefully that it still serves as a model. In a paper read before the International Medical Congress at Madrid, the writer, after careful studies, reached exactly the same results regarding ozena that Frankel had published about thirty years earlier. It seems as if the majority of authors nowadays coincide with his views on this subject.

Fraenkel was the first to publish his observations on what he called benign mycosis of the pharynx (*Berliner klin. Woch.*, page 94, 1873). Since then, we know that there is such an affection as pharyngomycosis leptothricia benigna. His contributions in *Eulenburg's Real Encyclopedia* are very numerous. In 1886 he demonstrated the infectious nature of lacunar tonsillitis, and by invitation read a paper on that subject before the Laryngological Section of the British Medical Association, July 30th, 1895. He has always tried to interest his students in the question as to how far Waldeyer's lymphatic ring is to be regarded as a portal for infections, and subsequently E. Meyer published "Bacteriologic Findings in Lacunar Angina" and "Fibrinous Rhinitis," both of which articles appeared in *Fraenkel's Archives.*

Next to Voltolini, Fraenkel was the first to call attention to the connection between nasal affections (polypi) and asthma (*Berliner klin. Woch.,* No. 16, 1881). For years afterwards, the question of reflex neuroses in laryngology dominated all others, and now that this subject has been cleared up we recognize the great debt we owe to Bernhard Fraenkel for his contributions in this field.

Among other articles belonging to this category, I would mention the one on "Hyperesthesia of the Nasal Mucosa" (*Berliner klin. Woch.,* No. 15, 1901) on "Railroad Coryza," and several notes in the *International Centralblatt für Laryngologie* for 1887, etc.

I must not omit to mention also the following papers: "On Empyema of the Antrum" (*Berliner klin. Woch.,* No. 11, 1887); "On the Submucous Application of Cocain" (*Ther. Monatsch.,* March, 1887); "Rhinologic Operations During the Era of Cocain" (*D. med. Woch.,* No. 51, 1889); "On Tracheotomy Without General Narcosis with Local Anesthesia" (*Berliner klin. Woch.,* No. 23, 1898).

Important are also his contributions on (1) "Carcinoma of the Larynx"; "First Removal of Carcinoma of the Larynx per Vias Naturales: Cure" (*Centralb. f. Chir.,* No. 24, 1886); (2) "First Cure for Cancer of the Larynx by Removal per Vias Naturales" (*Langenbeck's Archiv.,* Vol. XXXIV, 1886); (3) "Cancer of the Larynx: Its Diagnosis and Treatment" (*D. med. Woch.,* No. 1, 1889); (4) "The Intralaryngeal Treatment of Cancer of the Larynx" (*Archiv. f. Laryn.,* Vol. VI); (5) "Pachydermia and Carcinoma, etc." (*Archiv. für Laryn.,* Vol. XIII); (6) "Pachydermia of the Larynx: Its Histology, Pathologic Anatomy and Pathology" (*Archiv. für Laryn.,* Vol. II).

Fraenkel's studies in the histology of the larynx were extensive, and at one of the meetings of the Berlin Laryngological Society he made the assertion that the glands of the vocal cords were responsible for singer's nodules. His observations have not been published, but Fraenkel caused his assistant, Dr. Arthur Alexander, to pursue these studies, and he has embodied the results in "Histologic Contributions to the Formation of Benign Neoplasms of the Vocal Cords," of which so far only two parts have been published, and these are written in a very able and exhaustive manner.

Fraenkel also stimulated studies in paralysis of the vocal cords, and his experiments with Professor Gad are sometimes called historical. In 1896 he founded the *Archiv. für Laryngologie,* of which eighteen volumes have so far appeared, and, with all due respect to similar journals, it must be acknowledged that it is still the most important of them all.

His interest in tuberculosis dates back, as mentioned before, to his studies with the celebrated Professor Cohnheim, and his later work on this subject is very prominent. Very few of us know that in the impulse given by some of our German colleagues to the modern movement in tuberculosis, Fraenkel was the leading spirit — although as a member of the Board of Directors of the German Central Committee he has during all these years modestly kept himself in the background, so that only a few, a very few, are aware of his activity in that direction. That he was really the moving spirit is evidenced by the speech of the presiding officer of the Berlin Congress, Prince von Ratibor, who in his toast to Fraenkel spoke somewhat as follows: "Although every one was alive to the importance of such a congress and nature of its results, still there was one man who made this idea a reality—Bernhard Fraenkel—and I wish to give expression to the feeling of gratitude we all owe to him."

When we consider that this first Congress on Tuberculosis was followed by others of equal importance, namely those of Naples in 1900, London in 1901 and Paris in 1905, and that out of these congresses was developed the idea for a combined battle of all nations against tuberculosis, and when we furthermore consider how much good has already been accomplished in this direction, we can better appreciate the great good already derived from the zeal of Professor Fraenkel. That this battle against tuberculosis will benefit also laryngeal tuberculosis, I have no doubt, although I must admit that in this State there are many sanatoria which do not admit cases of laryngeal tuberculosis, holding the peculiar view that it indicates an advanced stage of the tubercular process, and that sanatoria have not been established to treat so-called incurable cases.

Fraenkel was the first to see miliary tubercles in the mucosa of the larynx, and he described them in *Berliner klin. Woch.,* No. 4, 1883. Virchow afterwards remarked that for the study of miliary tuberculosis, no organ was better adapted than the larynx. Since that time everyone has often observed such tubercles.

Fraenkel was much interested in Koch's bacillus, and his studies evolved a new method for staining the tubercle bacillus. This was in the year 1884 (see *Berliner klin. Woch.,* No. 13). Unfortunately Gabbet made an unimportant modification of this method, which he published in 1891, and which now goes under his name, but this is unfair, for Fraenkel deserves the credit for it.

His articles on the prophylaxis of tuberculosis, etc., are numerous, and it would take a long time to mention them all.

Fraenkel is the chairman and founder of the Berlin Laryngological Society, the meetings of which are held in his clinic in the Charité. In spite of his seventy years, he is still one of the most active members of that society. I understand that such active participation in scientific proceedings is not so common in other countries, and that in one of the largest cities of the Union the older members are never present in our special societies! I think we can all learn a great deal also in this respect from Professor Fraenkel.

In making these few notes on Fraenkel's life and his contributions to our special literature, I have not mentioned his many papers on general medicine and literature in general. We can appreciate, however, how much he has accomplished to establish a prominent position for laryngology in Germany, and in this respect he has achieved more than any other man before him. I am sure that all our German colleagues look up to him with pride for that alone. But it is not only the man of science and literature that we celebrate to-day, but the honest, upright man who has the rare faculty of inspiring his assistants and co-workers to renewed activity in the field of laryngology. So long as there is scientific research in that "little corner" of medicine which we call laryngology, so long the name of Bernhard Fraenkel will not be forgotten; and I know that our American confreres take as much pride and pleasure in the celebration of his seventieth birthday as do those of other nations. Let us hope that he may yet live for many years in good health as one of the great leaders of rhino-laryngology.

XLVII.

BERNHARD FRAENKEL'S CONTRIBUTIONS TO MEDICAL LITERATURE.

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NEW YORK,

AND DR. LANDGRAFF,

BELZIG.

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XLVIII.

DISEASES OF THE TRACHEA — ANOMALIES, HEMORRHAGE, INFLAMMATIONS AND INFECTIONS.*

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In opening the discussion on tracheal diseases, it is very evident that we must place some arbitrary limit on that portion of it assigned to the speaker. Otherwise there would be no limit to what might be properly presented. This reservation must be the excuse for the omission of much pertinent material.

At the outset, a plea is made for a more thorough examination of this structure by means of the laryngoscopic mirror than is often, and in fact usually, made. The introduction of the tracheoscope has by no means eliminated the utility of the mirror. Our fathers in laryngology learned much from its careful use in this direction, and, as is the case with all technical procedures, practice makes perfect. It is interesting to note the remarks of Morell Mackenzie on this point. Thus, he tells us, he was able to get a good view of the trachea in only thirteen of his first 100 hundred cases, in his second 100 of twenty-one, in his third of twenty-nine and in his fourth he was able to see the bifurcation in forty-seven. Our necessities are a good light and a somewhat higher position of the patient than we employ for laryngoscopy. The patient's head should be inclined slightly forward with the neck stretched, but without any upward tilting of the chin. The mirror should be held more horizontally than for laryngoscopy, and a still more horizontal position enables us to trace the tracheal wall upward from the bifurcation. The upper third of the posterior wall often eludes our vision by any method.

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* Contribution to Discussion on Diseases of the Trachea at the Twenty-eighth Annual Congress of the American Laryngological Association, at Niagara Falls, May 31st, June 1st and 2nd, 1906.

A lateral tilting of the glass brings the corresponding walls into view. Türck thinks that pressure on the tube from without may assist in this particular. It is sometimes of advantage to have the patient sit sideways on a chair and then rotate the head so as to face the examiner.

ANATOMY.—No particular advances have been made in our knowledge during the last few years. Zuckerkandl declares that the general statement that the trachea increases in width from above downwards is not true. In fact, he found the opposite to be the case in two out of four cases examined with reference to this point. It has been shown that islands of ciliated epithelium exist between areas of pavement epithelium. The vasomotor apparatus of the upper portion, in dogs at least, receives innervation through the superior laryngeal nerve, while the inferior sends fibres thoughout the entire tube. One case of diverticulum has been reported (Czyhlarz) due apparently to a local deficiency of elastic and muscular fibres. The tracheal axis does not always coincide with the median line of the body. The surgical significance of this fact is obvious. Low down on the left wall a pulsation is usually observed and is referred to the underlying pulmonary artery. The deviation from the normal axis suggests often that some compression may be present. As contrasted with pathologic conditions, it may be said that in the latter the parts are more congested, so that the distinction between the rings and pars membrana is lost. Moreover, changes in the patient's position and in the angle of the mirror will generally clear up all doubt. Finally, in spite of the apparent narrowing of the lumen, there is no dyspnea.

MALFORMATIONS.—Semon has reported the case of a girl with the trachea bent just below the larynx from right to left, but in the opposite direction lower down so that at the site where one would look for the bifurcation there seemed to be some influence on the outside pressing the tube inward. A strong pulsation was noted at this point. Several cases of tracheocele have been reported in the last ten years. These may arise from persistence of the branchial clefts or from pathologic changes. They are generally amenable to operative treatment. Most of them are small and have existed years without symptoms. Gregor mentions the case of a child of five months with symptoms of tracheal stenosis, proving fatal. Autopsy revealed an hour-glass contraction at the middle of the tube, the pars membrana being lacking at this point.

INFLAMMATIONS. — Perichondritis occurring about the trachea is generally secondary to typhoid fever, tuberculosis, syphilis or other infection. The rings are often bared and may be thrown off in pieces of various sizes. Naturally the tube contracts somewhat after this accident. Chronic perichondritis is a possibility, but is generally masked during life by symptoms referable to superjacent lesions. It occurs most frequently from scleroma, but has been ascribed to simple chronic catarrh. Irregular thickenings of the cartilages may start on a small area and spread through the submucosa, forming flat plates parallel to the rings. Ecchondroses may extend to the upper bronchi, and such have been noted during life. Ulcerations may occur in the trachea from intubation tubes. One interesting and unique case of erythema nodosum has been reported. The patient had a sudden attack of dyspnea necessitating tracheotomy. Recovery followed. Other dermatoses which have been noted in the trachea are herpes, impetigo herpetiformis, pemphigus, lichen ruber, erythema multiforme and angioneurotic edema. There is nothing to add under the latter heading to the comprehensive thesis presented last year by Halsted. Interesting observations have been made by Folina of the effects on rabbits' tracheal mucosa by complete nasal obstruction. The first lesion is the strong vascular congestion with destruction of the vessel walls and their consecutive confluence; then follow destruction of the epithelium, infiltration of the submucosa and disappearance of glands. Later the epithelium reforms, but the vessels remain shriveled, while the submucosa reduces itself to a very delicate layer, scarcely recognizable.

Acute catarrh is generally associated with that of the larynx and bronchi. It may be propagated from the nose and nasopharynx or from below upward. The general causes of bronchial inflammations apply equally well to the trachea. In fact, in many cases of so-called bronchitis, the inflammation hardly extends below the bifurcation. The symptoms of an attack need no enumeration here. Considerable swelling of the mucosa can occur without dyspnea. The amount of expectoration depends on the area of mucosa involved. The latter may take on a purplish hue. Ulcers may occur on the intercartilaginous portions. Mucus may remain adherent at one spot for several days and be mistaken for ulceration. Years ago, A. H. Smith of New York reported one case in which the trachea was lined with a plastic deposit which underwent a low degree of organization and became tough and fibrous like an old pleuritic adhesion. A laryngo-tracheotomy was done, but a complication of measles, interstitial pneumonia and diphtheria proved fatal. Sestier has reported two rather doubtful cases of primary tracheitis, the sequel being edema of the larynx. Phlegmonous inflammation almost always comes from the larynx or esophagus. Acute abscess is a great rarity. Chronic catarrh is a sequel of the acute or occurs as a part of chronic bronchitis in old people. The treatment of catarrhal conditions is essentially that of the accompanying bronchitis. There seems to be a greater conviction that creosote inhalations check secretion.

A word may be added referring to the occurrence of dysphagia as a symptom of tracheal inflammation. Years ago, Hyde Salter called attention to the fact that while the lower extremity of the trachea is fixed, the upper part rises with the larynx in the act of swallowing. The pain is most severe when the elevators of the larynx act most vigorously during this function, that is, when the chin is raised; whereas, if the chin is pressed against the neck so that these muscles cannot act with force, little or no pain is felt. Morell Mackenzie, however, records that he never saw this symptom present, and Salter's theory was not confirmed by laryngoscopic examinations.

Inasmuch as tracheal injections figure largely in modern therapeutics, a few words may be devoted to two new methods which have been brought forward. The first is that of Mendel, who says that if the tongue is held ouside the mouth as in ordinary laryngoscopy and the patient refrains from swallowing, the pharynx forms a funnel, the only inferior outlet of which is the glottis, for the gullet opening is closed except during swallowing so that a small quantity of liquid projected against the wall of the pharynx runs down into the air passages. This he styles the "median" method. He prefers, however, the "lateral" method described as follows: The curved canula is passed with its convexity firmly applied to the base of the left faucial pillar used as a support. The nozzle rests horizontally in the glosso-epiglottic groove and is hidden by the base of the tongue. The contents of the syringe are then discharged against the opposite pharyngeal wall with sufficient force to carom, as it were, around it and thus reach the posterior wall, whence they drop into the larynx.

Marangos injects through the nose. He denies that all of the injection by the Mendel method reaches the trachea. The fluid goes down not merely by its own weight, but is drawn down by inspiration. He passes the tube of the syringe through the nose so that the free end just clears the soft palate. In the adult from 12 to 15 c.c. of fluid may be used. The patient breathes normally with the head thrown slightly backward and the fluid is discharged drop by drop, synchronous with inspiration, the discharge being occasionally suspended. The patient can in this way inject himself. Marangos favors the use of gomenol with a little cocain.

TRACHEAL OZENA.—During the last decade, no small number of cases has been reported in which an ozena was present, not only in both the nose and trachea, but also in the trachea alone. There is no doubt that this process may be a primary one in the air tubes. We must distinguish these cases from a simple chronic, dry laryngo-tracheitis by their chronic course and fetid crusts. The source of the odor is still a matter of dispute. Fraenkel, who was the first to describe tracheal ozena, referred the odor to the disappearance of Bowman's glands and their secretions. Zaufal referred it to an abnormal widening of the air passages. Both of these theories originally suggested with reference to the nose have been opposed by Zarniko and Baginsky. Grünwald has suggested the idea of a substratum of keratosis of the pavement epithelium. The latest idea advanced by Löwenberg and Abel is that the coccus known by the name of the former is not identical with the bacillus of Friedländer, and is not the cause of the disease itself, though it may be the cause of the characteristic odor. As far as we know, there is no reason to doubt the essential identity of the lesions in the nose and trachea. The trophoneurosis theory has had a recent resurrection. On this basis, there first results a disturbance of nutrition, though no one can account for the peculiar sequence of events. A metaplasia of the epithelium follows with keratosis, superficial inflammation, crust formation and then through the inhalation of a certain organism (possibly Löwenberg's) the fetor. In one instance a pseudo-tubercular bacillus was found, although the sputa from the same case were negative. A few cases have been recorded in which the crust formation was so abundant as to threaten life. The possibility of using the tracheoscope in their removal under such circumstances has been suggested. There is some danger of pushing them down in trying to dislodge them. Tracheotomy has been done in one instance by our colleague, E. J. Moure. In one instance the crusts formed a blackish viscous layer reaching down to the bifurcation. Remedies suggested are menthol inhalations and injections, injections of watery solutions of naphthol, applications of phenol sulforicinate in 30 per cent solution, injections of guaiacol in albolene, etc. Frequently the mucosa of the trachea becomes quite insensible and this favors the application of mechanical measures. The accessory sinuses must not be overlooked in our efforts to clear up obstinate cases.

One remarkable case may be summarized. It is reported by Dupond and occurred in the hospital service of E. J. Moure. A sailor was admitted suffering from laryngeal dyspnea. The left cord was immovable in the median line, the right moved slowly. Nasal ozena was found. During the laryngeal examination, the cords moved suddenly and crusts were seen in the trachea. Expectorant measures were ordered, but before they could be used the man expelled a mass of crusts the size of a pigeon's egg. Accumulation had led to a diminution of laryngeal sensibility owing to the impairment of the sensory nerves by the atrophic process; hence the absence of a greater severity of symptoms. Respiration was labored, wheezing and noisy. The voice was low and husky. Under a short course of benzoate of sodium internally and sulphur inhalations the man spoke and breathed freely, other masses having been expelled. Dupond believes that the process advances with greater rapidity in the trachea than in the parts above, owing to its greater size and its rigid walls which increase the difficulty of expulsion of the crusts and thereby favor their stagnation and decomposition.

A few cases of inflammation have been ascribed to the effects of drugs taken internally. Thus Réthi has reported one case of laryngeal and tracheal inflammation in a patient taking Fowler's solution, dose not stated. The symptoms subsided immediately on the withdrawal of the remedy.

TRACHEAL HEMORRHAGE.—During the last few years, an interesting series of cases has been placed on record under the varying designations of hemorrhagic tracheitis, hemorrhagic tracheal catarrh, tracheal hemorrhage, etc. The most striking feature about them is that, in fully one-half the cases, the existing cause has been regarded as influenza. Nearly all of them have occurred in young adults or in persons approaching middle life. They have been about equally divided between the sexes. Considering the prevalence of influenza during the last fifteen years, such cases are probably more common than reports would lead us to believe. Many physicians have seen cases of hemoptysis in which the lungs, so far as could be determined by our present methods of examination, were healthy and which upon the cessation of the bleeding have been dismissed, while the exact cause of hemorrhage has remained a mystery. It is easy to dismiss the question by saying that such cases have been those in which the bleeding could be regarded as one expression of the hyperemia which is so often the first manifestation of the pulmonary tubercle, so that the diagnosis has not been easy, but too many of them have been kept under observation for a long time to make one believe that they do not deserve a separate classification.

In nearly every case, there has been a history of more or less recent influenza and of more than one attack. There has been a tickling irritation in the lower throat and the sensation as of a foreign body. There has been a short dry cough, the more intense the more recent the influenza. Unless the latter malady has been still evident, there has been no rise in temperature, and such rise if present has been slight. Certainly the charts have presented none of the features of incipient phthisis. The bleeding has come on suddenly and has been repeated at intervals of hours, days and even months, but in the event of repetition there has usually been a recurrence of the influenza. As a rule, but two or three ounces of blood have been raised; in one or two cases there has been a true bronchorrhagia. Some have emaciated, but this may have resulted from the initial disease. Examination of the chest has given no evidence of involvement of the pulmonary parenchyma. Occasionally, in examination of patients with recent influenza, there may have been a few moist rales and even traces of broncho-pneumonia. There has been a distinct absence of the classical signs of incipient tuberculosis. Bacilli have been absent, but this finding has had, of course, only the same relative positive and negative values as under ordinary circumstances.

The laryngoscope has brought to light a peculiar condition in the mucosa of the upper trachea, best seen if the examination has been made just as the bleeding has been passing off. If we examine the trachea during an ordinary subsiding hemoptysis, and are fortunate enough to secure a good view, we generally find it lined with clot or clot patches throughout its entire length. In many of the cases referred to, it has been possible to get a view way down to the bifurcation, and the lower portion has been found entirely clear. The lesion has been confined to the subglottic portion. It has consisted, to use a single descriptive phrase, of a varicose condition of the tracheal vessels. In all the cases reported, this definite view has been obtained. At times the vessels have been seen running parallel to the tracheal rings, or perhaps converging toward the subglottic area or irregularly scattered like small leeches over the upper tracheal wall, and blood has been actually seen oozing from them. Rest, opium and ice pellets have been of service in treatment, and an astringent spray has toned up the vessels, while tonics as strychnin, cinchona, etc., have completed the cure in uncomplicated cases.

As regards the direct relation of influenza as an etiologic factor, we must remember that this region is among those affected, and primarily so in pretty much every case of the disease. We know that this region is very vascular, and it is just at this point that the impact of respiration, phonation and cough converges. Considering then the local diminution of resistance and the systemic weakening of the influenza, it is natural that such a condition as that described should be brought about. It may follow from other causes than this special infection. In one instance it seemed to be the initial manifestation of cirrhosis of the liver.

It is only fair to note that some of these cases, in which tracheal varices have occurred, have later passed on to the category of full-fledged cases of pulmonary tuberculosis, so that considerable time must elapse before we are sure of our position in a given case. Therefore, we must admit that while tracheal hemorrhage may exist independently of pulmonary disease, it may be present also as a distinct lesion in persons who later develop lung disease. In all the cases reported under the classification, a most careful search has been made for tubercle, but none has been found except in those which have passed on to tuberculosis as above specified. Two reflections are pertinently suggested by the author, who has reported the largest number of cases. The first is that greater reserve is necessary in making a diagnosis of pulmonary tuberculosis in patients who have bleeding, emaciation, slight fever and suspicious chest signs; the second is that some cases regarded as cured incipient tuberculosis may have been only recoveries from tracheal bleeding as a sequel of influenza.

TUBERCULOSIS.—In an excellent paper by our colleague, Dr. Jonathan Wright, on Tracheal Syphilis, published in 1891, he discusses among other topics that of differential diagnosis from tuberculosis, quoting Vallette as saying that "tuberculosis of the trachea is usually only a feeble episode in the laryngeal and pulmonary trouble which it accompanies." This expresses, for nearly every case, the true state of affairs. In fact, Wright refers to one case of Vallette's as the only one he could find in which the trachea alone was affected. I have gone over the literature of the subject since the date of Dr. Wright's paper, and have been able to find notes of three additional such cases. One of these is reported by Hansemann, who found, on autopsy on a woman of 73 years, tuberculous disease of the trachea from the bronchi up to the larynx, but no trace whatever of tuberculosis in other tissues. In the discussion of this case, Schmorl related the histories of two others with the same limitation of lesion. One was found in a man dying from typhoid fever, the other in a child of 8 years, the exact cause of death not being given. Cases with coincident involvement of the larynx and bronchi are matters of daily occurrence. Tracheal ulcerations here are more marked on the posterior wall and are often found in advanced cases when the patient becomes bedridden. This is doubtless due to the long-continued contact with the mucosa of a tenacious agent such as bacilli-laden sputum. Naturally, from proximity, the upper portion of the trachea suffers more than the lower. The pathologic changes present no peculiarities. The tube is generally thickly coated with mucus, though it may not be produced at this site. The ulcers are generally chronic, but may run an acute clinical course, fuse and become of considerable size. In one of Schrotter's cases, the entire surface from the sixth ring to the bifurcation formed one large ulcer. Ulcerations may penetrate the wall of the tube, but unless they do so, they add no special symptoms. A view of the trachea is often impossible, owing to the swelling of the laryngeal structures. When the former becomes infected in its lower parts, such infection probably comes from the bronchial glands. Weichselbaum saw one case, in which perforation took place into the trachea and esophagus from extension from the glands named. Schrötter has seen cases of involvement of the upper portion of the tube, which he could explain only on the same theory of infection from the glands.

No enumeration of the features of tuberculosis of the trachea should omit reference to the rare tuberculoma first described by our associate, Dr. J. N. Mackenzie, nearly twenty-five years ago. I am greatly indebted to him for an interesting personal communication giving his own experience in this direction. Several other cases purporting to be similar have been reported, but the majority of them have either been wrongly classified or the evidence adduced in their favor is not convincing. By the term used, Mackenzie refers "not simply to a lesion containing the bacillus, but to a distinct definite characteristic tumor-formation covered by unbroken epithelium and consisting of a mass of miliary tubercles set in a vascular network of connective tissue and exhibiting all grades of tubercular degeneration up to cavity formation." It will be observed that this condition is sharply defined from mere mound-like infiltrations. In the communication referred to, Dr. Mackenzie states that he has seen, in all, three cases in which the diagnosis was established microscopically beyond a doubt, and two others in which no histologic examination was made. To these rigid standards, the loose statements of several other writers do not conform and their diagnoses of their respective cases cannot be accepted, still less their claims to have been the discoverers of the condition.

SYPHILIS.—The following may be enumerated as the specific lesions which may involve the trachea: catarrhal inflammation, erythema, condyloma, gummi, ulceration, perichondritis and cicatrices. Catarrhal inflammation has no special appearance or symptoms and a diagnosis of such as a specific manifestation could be made only in the presence of other and conclusive evidences of this infection. Of the so-called secondary infections, erythema and condyloma are rarely observed, probably because they are overshadowed by the extreme changes in the larynx. Erythema might cause irritation, but no symptoms would arise from condyloma until ulceration occurred. In one case reported by Harrison Griffin, a broad projecting granular mass was visible upon the anterior wall immediately under the cords, running backward about an inch and causing considerable narrowing of the lumen. It was of a reddish color with a skin-like secretion. It had sharply defined limits and its upper surface was irregularly fissured. Under the internal use of the iodids and inunctions over the thyroid cartilage it disappeared in three weeks. Condylomata are not always reddish, but sometimes appear as white spots or as thickenings with superficial ulcerations.

Circumscribed gummata are rare, especially in the upper portion of the tube. Parker has reported the case of a boy of 15 years with inherited syphilis who, on autopsy, showed dense fibrous tissue in connection with the mucosa and submucosa. At one point, the lumen was reduced to a diameter of one-quarter of an inch. Tracheotomy had been done and the fistula closed later. Death resulted from catarrhal pneumonia. The effects of the inflammation began somewhat abruptly, one and one-half inches above the bifurcation, and increased downward. Extreme interstitial inflammation compressed both bronchi and alveoli. The smaller tubes and alveoli were full of fetid pus. Beale notes that such forms of obstruction always occur at the lower end of the tube. Gerhardt explains this localization by the fact that the lower parts are more liable to injury by cough and by the additional fact that the pulsations of the pulmonary artery always keep the tracheal wall in a constant state of vibration. Next in frequency, as to site of lesion, is the upper portion, by direct extension from the larynx.

Infiltration may come on years after the body has been free from a syphilitic lesion. The process seizes on the cartilages and leads to inflammation and necrosis. If not treated, we have the usual sequence of softening, ulceration and destruction. Infiltrations are often ring-like. Membranes are more rare than in the larynx from the same cause. Here may be cited the remarkable case described in the candidate's thesis of our president, Dr. Gleitsmann, presented to the association in 1880. His patient was a woman of 32 years who presented along with various other lesions the "seeming appearence of a second glottis far below the normal one. Two dark red symmetrical membranes ran horizontally from back to front of the trachea, with a very small longitudinal opening between them, which was wider posteriorly than anteriorly. They remained immovable during respiration and phonation, and were localized in the region of the fifth or sixth tracheal cartilages. Their surfaces and free margins did not show any signs of ulceration. It was impossible to determine their vertical thickness." Under systemic and long-continued treatment these adventitious bands entirely disappeared.

With a desire not to trespass on the ground of other participants in this discussion, I omit reference to the various contractions and stenoses which may result from specific disease. Ulcerations sometimes lead to deplorable results. Diffuse peritracheal and bronchial syphilomata have been noted. The clinical aspects of these various lesions are modified by the fact that the bronchi and lungs are often synchronously affected. Various forms of paralyses are simulated by the results of pressure and contraction. Downie declares that hereditary syphilis is more often the cause of ulcerations here than is acquired disease. The symptoms comprise in varying combination hemoptysis, cough, dyspnea and stridor. Often the cough and sputum suggest tuberculosis, the breathing and respiratory spasm, laryngeal stridor. Ulceration may perforate the aortic arch. In a general way infiltration and gummata give no symptoms until narrowing of the lumen occurs. Ulcers may cause cough and pain. Sputa are mucopurulent and purulent. In the latter stages of infiltration we have reaction in neighboring parts. Rings and membranes give evidences of stenosis. In marked stenosis we have fever and symptoms of pneumonia.

The diagnosis is generally easy. The systemic history is taken into account, and a careful examination should be made of the entire body for stigmata of syphilis. If the larynx is free, examination is generally easy, because it opens widely and the epiglottis is instinctively elevated. Involvement of the larynx often precludes a view of the trachea, and the diagnosis must be then made by exclusion. Here, as elsewhere, the iodid often clears up many obscurities.

Differential diagnosis is called for from tuberculosis, scleroma, ulcers of other varieties, tumors and foreign bodies.

Scleroma generally begins in the nasopharynx and spreads downward, generally affects a large area, has no ulcers and runs a long course, even over decades.

In tuberculosis, we almost always have ulcers in the larynx and we are helped by the results of chest examinations and by the finding of bacilli in the sputum. Tuberculin injections may solve the problem.

Of tumors, the most common are fibromata and papillomata. Glandular masses and malignant disease resemble gummata.

Foreign bodies are often overlooked because covered with granulations.

The treatment is that of the specific disease in general, together with such topical applications and mechanical measures as the individual case may demand. H. von Schrötter has recently employed the tracheoscope in one case for locating a specific lesion which was found at the bifurcation and was removed by internal medication, as was verified by subsequent examinations. He warmly commends the use of this instrument in order to make the diagnosis and treatment more accurate.

As a practical matter, it may be observed that it is hard to separate syphilis of the trachea from an accompanying lesion of the bronchi. Reference may be made here to the valuable paper of L. A. Connor in 1903 on Tracheal Syphilis. His statistics are of interest. He has analyzed 128 cases recorded in literature and occurring in his own practice, finding that twenty of these were gummata, fifty-one ulcers, while of endotracheal connective tissue new growths, distinct scars were noted in forty-seven and diffuse thickenings in thirteen. Fibrous peritracheitis was present in eight. The trachea alone was involved in 56 per cent, trachea and bronchi in 33 per cent and the bronchi alone in 11 per cent.

Out of Connor's 138 cases there was a mortality of 76 per cent. Of fifty-eight cases in which the immediate cause of death was given, nineteen died from pneumonia, four from perforative hemorrhage, eleven from sudden paroxysmal dyspnea and the remainder from gradual exhaustion. Of twenty-nine rationally treated, fifteen were cured, eleven improved, while but three failed to respond to treatment.

A word may be added concerning scleroma. Inasmuch as the programme for to-morrow contains a paper on this subject, which will be thoroughly dealt with, no reference is made here to the histology of the disease. Suffice it to say that while its occurrence in the trachea is generally secondary to that in areas above, it may here occur as a primary lesion. According to the stage to which it has progressed, we have dyspnea, crust accumulations, cough, scarring and stenosis. There is no specific treatment. Symptoms must be met by suitable measures which embrace inhalations, mechanical removal of crusts and infiltration deposits, and the various surgical measures which are proper for stenoses from other causes.

XLIX.

TUMORS OF THE TRACHEA.*

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ALBANY.

Bruns, in his very complete article on the neoplasms in the air passages (trachea), states that the first observation of a tracheal tumor was in 1767, by Lieutaud. The patient in whom it was observed, a boy, died of a sudden attack of dyspnea, and a polyp with a long pedicle, which had been carried into the glottis by the air current and had caused the sudden death, was found. After the introduction of the laryngoscope, the reports of tracheal tumors became more frequent.

Türck, in 1861, was the first to observe a tumor in the upper part of the trachea in the laryngeal mirror. After him, cases were reported by M. Mackenzie, Schrötter and Störk. This rare occurrence of tracheal tumors is in great contrast with the frequency of laryngeal tumors, as Semon, in 1889, collected over 10,000 cases of benign laryngeal neoplasms (Bruns). According to these figures, tracheal new growths as compared to those occurring in the larynx, would be less than 1 per cent; or, in other words, the relation would be approximately 100 laryngeal growths to 1 in the trachea.

Bruns' personal observations are somewhat different, as he observed 300 laryngeal growths to 7 in the trachea.

Moritz Schmidt, out of 42,635 cases of diseases of the upper air passages, observed 2,088 new growths, of which 748 were laryngeal, and only 3 tracheal.

Bruns states that the slight tendency of the trachea to the development of new growths may be explained by the fact, that the trachea, which is a simple, rather rigid, smooth tube, has practically only the passive function of the passage of air, while the larynx has a complicated structure, and such a function that its parts are in almost constant motion. This also explains, perhaps, the slight tendency of the trachea to primary catarrhal inflammations, and the fact that the majority of tracheal tumors are in the upper part of the trachea, and the smallest number in the middle, because particularly this part of the trachea is so well protected from irritation of all kinds.

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*Read before the American Laryngological Association, May, 1906.

In order to study the subject, the statistics of the different writers had to be consulted. The valuable theses of Müller (3), Koch (1), Orth (4), Schrötter (5), Lemoine (7), Scheuer (6) and Bruns' monograph (8), were of great assistance in preparing this paper. Many of the original reports of cases were also consulted. J. Solis-Cohen's paper (18), in Ashhurst's Encyclopedia of Surgery, was also of great value.

Granulation tumors resulting from tracheotomies and the wearing of tracheal canulas, and the syphilitic or tuberculous granulomata are not considered genuine tumors, and are not included in this paper. The writer's paper is based on a study of most of the authentic cases of primary tracheal tumors in the literature, one hundred and thirty-five cases in all. Other cases have been reported, but in some of them there was some doubt of the diagnosis and in others the data were insufficient.

Of the 139 cases, 85 are benign and 46 malignant.

BENIGN NEOPLASMS.

The benign new growths occurring in the trachea are about the same as those observed in the larynx. The following varieties occur in the trachea: The fibroma (polypus, fibrous polypus), the lipoma, the papilloma, the ecchondroma and chondroosteoma, the adenoma, the intratracheal goitre or struma and the lymphoma. Of the malignant neoplasms, only the sarcoma and carcinoma have been observed occurring primarily in the trachea.

INTRATRACHEAL STRUMA.

Considering first the benign growths, we find that the intratracheal struma is one of the rarest as well as one of the most interesting forms.

Cases of intratracheal struma have been reported by Ziemssen (73), Bruns (74), Heise (75), Roth (77), Paltauf (78), Baurowics (80), Freer (81) and Theisen (82).

Three cases, those of Neumayer (7) and Frankenberger (72), reported as cases of struma, have not been included in this list, because the diagnosis was not proved in any of the cases.

Abstracts of the reported cases of intratracheal struma will not be given, because they were published in the writer's original paper, "A Case of Intratracheal Colloid Struma—Operation," in the *American Journal of the Medical Sciences,* June, 1902 (82). A full report of the writer's case was published at that time, with the histologic diagnosis, which was "colloid struma originating in thyroid tissue situated beneath the submucosa of the trachea."

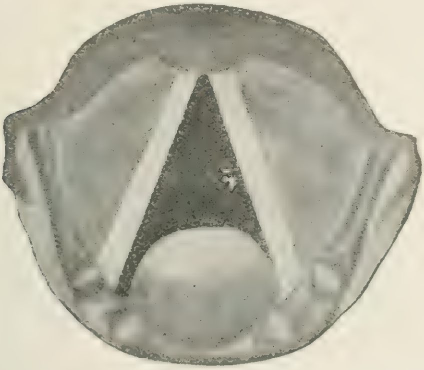

Fig. 1. Writer's case. Intratracheal struma.

It may be of interest to mention at this time, that the tumor, which was removed by tracheo-fissure Nov. 16, 1901, and which extended downwards along the posterior wall of the trachea from the first ring for a distance of 5 cm., has not returned. I examined the patient a few months ago, and found the trachea clear with the exception of a little thickening where the tumor had been attached to the tracheal wall. Fig. 1 shows the tumor as it looked on laryngoscopic examination, and Fig. 2 shows a drawing of a section, low power.

As the etiology of this class of benign intratracheal growths has been so well studied, I will consider it rather thoroughly. Up to the time of Paltauf's investigations (78) it was, however, rather obscure.

The two theories as to the origin of this most interesting form of tumor that have received the most consideration, are those of Bruns (79) and Paltauf. Bruns and Heise, the chief exponents of the embryonal theory, held that in intrauterine life a small accessory thyroid lobule from aberrant embryonic rudiments of the thyroid gland (Angeborene Verlagerung von Schilddrüsengewebe) must have, in such cases, been present in the fetal larynx or trachea. This lobule, developing about the time of puberty, resulted in the true intralaryngeal or tracheal so-called "accessory thyroid tumor." Paltauf was able to prove in his case, by microscopic examination, that this theory was not tenable. In his case, there was a connection between the intratracheal growth and the thyroid gland externally. The thy-

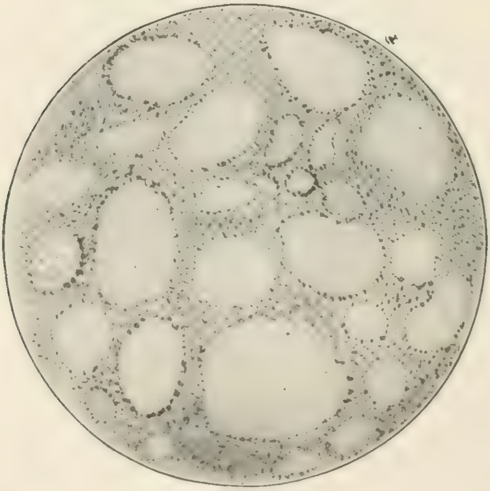

Fig. 2. Drawing of Section. Low power.

roid was so firmly attached to the cricoid cartilage and upper three tracheal rings, that it could not be separated from them. The space between the cricoid and first tracheal ring, and a portion of the external lateral lobe of the thyroid, which was firmly adherent to the cartilage at this point, were examined microscopically, and he was able to prove positively that the thyroid tissue had penetrated (through the interstitial membranes) to the perichondrium and submucosa on the inner surface of the trachea, the cartilage itself remaining intact. This observation of Paltauf's is the first instance on record of normal thyroid gland tissue penetrating to the interior of the trachea, although Orth (86), in his Pathological Anatomy, makes the statement "that strumas, but particularly malignant neoplasms, could penetrate into the air passages."

Paltauf's conclusions, that these tracheal tumors springing from thyroid tissue do not owe their origin to an intrauterine deposit of thyroid tissue, are of great interest. They should, therefore, not be called accessory thyroid tumors. They originate in extrauterine life by penetration of the gland tissue between the cricoid and thyroid cartilages, between the cricoid and first tracheal ring, between the upper tracheal rings and through the interstitial tracheal membrane itself, from without. When this occurs, it should be considered as a direct extension of an enlarged thyroid gland—a parenchymatous struma. Proof of this assertion is that the thyroid gland has really grown fast to the cricoid cartilage, interstitial membranes and upper tracheal rings. This abnormal adhesion can neither be explained by pressure nor by an inflammatory process, but can have occurred only during the formation and development of the thyroid gland, and only in the way that the fetal gland, in these cases, must be united with the perichondrium of the cartilage and the interstitial membranes.

Gruber's investigations (83), perhaps, would give additional support to Paltauf's theory. He found, after examination of many Russians and Bohemians, that there was often an accessory or really an extra lobule, extending downward from the lowest posterior margin of the lateral lobes and lying very close to the trachea. These extra lobules may also lie in the crico-thyroid space. The only parallel cases that possibly give some support to Bruns' theory are those observed by Streckeisen (87). He found on sections through the hyoid bone seven times the so-called glandulæ intrahyoideæ; that is, thyroid tissue was shut in the bone. He believes that this was shut in during the ossification period.

In my own case, it could not be determined during the operation whether the left lateral thyroid lobe, which was enlarged, was adherent to the trachea or not. The isthmus was not, because, in ligating it, the ligatures could be passed readily between it and the trachea. It is a rational deduction, however, from the fact that the intratracheal growth was really part of the tracheal wall, and springing as it did from the posterior and left lateral wall, that in this case, too, the intratracheal tumor was really an offshoot from the left lateral thyroid lobe.

An analysis of ten cases of this class of tumors brings out a number of interesting points: (a) The location of the tumors in all the cases, with the exception of Bruns' last case, was characteristic. They were all situated in the lower part of the larynx and upper part of the trachea and attached to the lateral and posterior walls. Bruns' last case was the only exception to this rule, the growth being attached to the anterior wall. (b) This point decides another interesting fact before mentioned, that these tumors, for this reason, should not be called accessory thyroid tumors, because they are really offshoots from the thyroid, as proved in the majority of the cases by the adhesion of the thyroid to the tracheal wall, and in Paltauf's case, microscopically, by the infiltration of the interstitial membranes with the follicles of the thyroid gland. (c) They were all observed early in life, from the fifteenth to the thirty-third year, with the exception of Roth's case (77) (the fortieth year). (d) A goitre of moderate size was present in all except in one of Heise's and in Freer's case. (e) They occurred in both sexes—three in males and seven (including the author's) in girls and young adult women.

PAPILLOMATA.

The tracheal papilloma is one of the commonest benign tracheal growths, and usually occurs together with multiple laryngeal papillomata. The majority of the cases of tracheal papilloma occur in children.

Six of the recorded cases of tracheal papilloma are undoubtedly congenital, because the children were hoarse and there was dyspnea from birth.

Bruns has found the same to be true of laryngeal papilloma in children, about one-fourth of the cases being congenital. (Bruns, P. Die Laryngotomie z. Entfernung intralaryngealer Neubildungen, Berlin, 1878, S. 179.)

Cases of tracheal papilloma have been reported by Davis Colley (11), Maissonneuve (10), Bruns (9), Schrötter (12), M. Mackenzie (13), Labus (15), M. Mackenzie (14), Butlin (16), Labus (17), J. Solis-Cohen (18), Schaller (19), Teschendorf (20), Chiari (21), Siegert (22), Weil (23), Störk (24), M. Mackenzie (26), Störk (25) and Krishaber (27).

A study of the reported cases shows that in a little less than one-third of the number, the paillomata were confined to the trachea, and occurred mostly singly, varying in size from a pea to a pigeon egg. They are usually found in the upper part of the trachea, and in the majority of the cases are attached to the anterior wall, although they also occur on the posterior and lateral walls. Siegert (22) has reported a papilloma as large as a pigeon's egg, close to the bifurcation, and Störk (25) has also reported a case in which the growth was close to the bifurcation.

Chiari (21) diagnosed, with the laryngeal mirror, a case in which the growth was attached to the posterior wall at about the tenth ring. Maissonneuve (10), in 1856, at autopsy, found in the trachea of a boy, aged 10 years, numerous reddish-white vegetations which extended upwards to the vocal cords. They had started about two years before death, with catarrhal symptoms of the air passages.

Störk (24) observed another case in a man, aged 22 years, in which multiple papillomata were present in the trachea at the level of the third ring, with numerous laryngeal papillomata.

Labus (45-48) has reported three cases removed per vias naturales. In the first case there were papillomata of the left vocal cord, and others in the trachea (fifth to eighth rings). Removed with forceps, but recurred every three or four months. Final cure was obtained.

Second Case.—Small growth at level of third ring in boy, 13 years old. Removed with forceps. No recurrence after five years. Although a diagnosis of fibro-sarcoma was made in this case microscopically, it was probably not malignant from the fact that there was no recurrence after an endotracheal removal.

Third Case.—Tracheal papilloma, in a man, aged 63 years, at the level of the fifth ring. Removed with forceps in different sittings.

J. N. Mackenzie (Tr. Amer. Laryn. Ass., 1898) describes tuberculous tumors in the trachea, which at times take the form of papillomata.

Bruns (9) has reported two cases of tracheal papilloma in children, aged respectively 7 and 10 years, occurring in conjunction with multiple laryngeal papillomata. In the case of a child of 5 years dying in a suffocative attack (Teschendorf, 20), a mass of papillomata extending from the epiglottis to the bronchus was found, and in another case, a child, who had also died during an attack of suffocation, the trachea at autopsy was found to contain numerous papillomatous excrescences extending almost to the bifurcation. Reported by Schaller (19). Sudden deaths of this kind have occurred mainly in children, the only adult case of which I could find any record was the one reported by M. Mackenzie (26). Sudden death was produced in this case by a papilloma as large as a bean.

LIPOMATA.

Only one case of genuine lipoma has been reported, by Rokitansky (36) (Fig. 3). At the autopsy of a man, aged

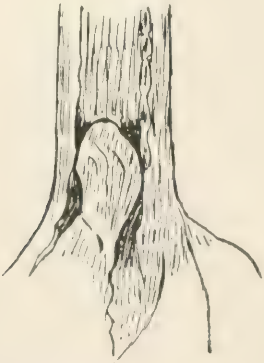

Fig. 3. Rokitansky's case of lipoma of the trachea. (After Schroetter.)

85 years, a lipoma as large as a hazel nut was found in the left bronchus.

In another case, that of Chiari (35), a primary bronchial tumor turned out to be a mixed lipoma and adenoma. The case was that of a woman, aged 68 years, who had died of emphysema. It was made up mainly of fatty tissue.

LYMPHOMATA.

I could find records of only two cases of lymphoma of the trachea. They were reported by Clark (37) and Volger (38).

In Clark's case, that of a woman aged 75 years, a tracheotomy which resulted in the death of the patient, had been performed for urgent dyspnea. The growth was found at autopsy.

In Volger's case, that of a girl aged 19 years, a round tumor as large as a cherry attached to the lateral tracheal wall, could be seen with the laryngeal mirror. It was removed by tracheo-fissure.

ADENOMATA.

Seven cases have been reported, by Radestock (29), Chiari (31), Mayer (30), Scheuer (28), Kolisko (32), Paltauf (33) and Rosenheim (34).

They are round tumors, originating as hypertrophies of the mucous glands. They are as a rule only slightly movable, and have their seat on the posterior wall of the trachea.

In Rosenheim's case, that of a young man aged 23 years, a small, red, immovable tumor was seen in the upper part of the trachea. It was removed by tracheotomy and was found attached to the cricoid and upper tracheal rings. Diagnosis: Colloid fibro-adenoma.

Scheuer reported the case of a woman, aged 56 years, in whose trachea a round tumor about the size of a cherry was found on laryngoscopic examination. It was attached to the posterior wall by a thick pedicle at the level of 6-8 rings. Removed by tracheotomy. Kolisko and Chiari have reported cases of adenoma of the bronchi. Chiari's case occurred in a man 73 years of age, who had died of tuberculosis.

FIBROMATA (FIBROUS POLYPI).

Cases of this kind have been reported by Rokitansky (51), Stallard (54), Eppinger (55), Türck (52), Maissonneuve (53),

M. Mackenzie (56), Fifield (57), M. Mackenzie (58), Crutchley-Mackenzie (59), Ingals (60), Avellis (64), Braun (63). Masini (62), Lewin (61), Mackenzie-Johnston (65), Oazmann (66), Bidwell (67), Jurasz (68), Bockenheimer (69) and Fournie (70).

Rokitansky, in 1851, reported the first pedunculated fibroma situated at the bifurcation of the trachea. He did not describe it accurately.

I will give brief abstracts of only the most interesting cases.

Türck reported the case of a fibroma found at autopsy. The patient, a man aged 37 years, had died of tuberculosis. It was situated in the upper part of the trachea, and was attached to the posterior wall. Stallard found in the trachea of a man, aged 40 years, who had died during an attack of suffocation, a polyp as large as a tonsil. It had been attached to the anterior wall of the trachea, high up.

In Eppinger's case, a man aged 23 years, who had died suddenly, a round tumor as large as a hazel nut was found on the posterior wall of the trachea, 4.5 cm. above the bifurcation. The diagnosis was made microscopically.

M. Mackenzie has reported four cases of tracheal fibroma, all the cases he observed.

In the one case, a man aged 41 years, the growth was attached to the anterior wall of the trachea at the second ring. In the second case, a woman aged 22 years, the tumor was attached to the posterior wall at the third ring. In an attempt to destroy this with the cautery both vocal cords were injured.

In the third case, a man aged 37 years, and in the fourth case, a man aged 45 years, the polypi were attached to the anterior wall, in the one at the second ring and in the other about the fourth ring.

In two of Mackenzie's cases, the polypi were destroyed with the cautery. In the fourth case, the patient refused operation, and died suddenly a few months after returning home, probably of asphyxia.

Ingals has reported a case of tracheal polyp in a man aged 60 years.

In a case reported by Lewin, in which a fibroid polyp was attached to the posterior wall of the trachea, a tracheotomy was performed, and the patient wore the canula twenty-four years. He refused any other operative procedure.

Mackenzie-Johnston and Oazmann have also reported cases of tracheal polypi. In Mackenzie-Johnston's case the growth was removed by tracheotomy, and in Oazmann's case it was removed endotracheally.

Altogether I could find records of twenty-four cases of tracheal fibroma, although there are undoubtedly more. Of this number, fifteen were pedunculated and nine were attached by a broad base. They were situated about equally in the upper and lower parts of the trachea, and attached to the anterior and posterior walls in about the same number of cases.

In the majority of the cases, they occurred in middle life, only three cases having been observed in children between the fifth and fourteenth years. In eight of the reported cases, sudden death from suffocation occurred.

ECCHONDROMATA AND CHONDRO-OSTEOMATA.

The solitary cartilaginous tumor of the trachea is almost unknown. Only one case could be found, that of Berg (*Virchow, Jahresber,* **11, p. 206, 1890). He observed a tumor** as large as a nut at the fifth tracheal ring. It was removed by tracheo-fissure and was found to be made up of cartilage.

Other ecchondromata and osteomata have been reported by Solis-Cohen (41), Virchow (40), Ganghofer (39), Chiari (42), Heymann (43), Steudener (44), Hammer (45), Wilks (46), O. Chiari (47), Schrötter (48), Mischaikoff (49) and Klebs (50).

Very little is known in regard to the genesis of this interesting class of new growths.

H. Chiari (42), in 1878, described the formation of osteomata in the trachea of a man, aged 25 years, who had died of tuberculosis.

The first case of this kind was probably described by Wilks (46), in 1856. In this case, that of a woman aged 38 years, there was a formation of bone in the mucous membrane of the trachea. His patient died of pulmonary tuberculosis, and at the autopsy the whole inner surface of the trachea was covered with small movable bony plates, which were fastened to the anterior wall. No connection could be discovered with the tracheal rings.

Heymann (43) has reported a similar case in a woman, aged 61 years. In his case, a tracheotomy was performed and later a thyrotomy, resulting in the death of the patient.

Five other cases have been reported by Hammer (45).

J. Solis-Cohen (41) found in the trachea of a tuberculous patient, after death, a considerable number of minute, closely aggregated ecchondromata beneath the mucous membrane.

As will be seen from a consideration of these cases, such bony and cartilaginous formations in the trachea are practically always multiple. They have all occurred in adults between the twenty-fifth and sixtieth years.

The causes of death in cases in which this condition was found, were seven times tuberculosis, four times pneumonia and in one case each laryngeal perichondritis, meningitis, brain tumor and carcinoma of the uterus. Tuberculosis would appear to play rather an important role etiologically, although in what way has not been determined.

Mischaikoff's investigations (49) have, perhaps, helped to clear up the origin of these tracheal chondro-osteomata. He claims they do not develop from the ordinary connective tissue of the mucous membrane, but from strands of connective tissue springing from the perichondrium. This is brought about, he states, by an anomaly in the development of the tracheal cartilage.

MALIGNANT NEOPLASMS—CARCINOMATA.

Primary carcinoma of the trachea occurs most frequently as a medullary carcinoma, and exceptionally as a cylindroma (Koschier).

Langhans has shown, in a number of cases, that these neoplasms originate in the mucous glands of the trachea.

Bruns (104) has reported a case that shows a probable malignant change in an intratracheal struma. As this is the only case of which I could find any record, in which an extensive resection of the trachea was performed, I will report it rather fully.

The patient was a man, aged 31 years, who had suffered from slowly increasing dyspnea for many years. On laryngoscopic examination, the trachea was seen to be filled with rounded, nodular masses attached to the posterior wall. Bruns resected the trachea, including eleven rings, and extirpated the growth. The patient lived for six years. The histologic examination showed it to be an adenocarcinoma, probably an intratracheal malignant struma.

Tracheal cancer appears to favor the male sex; out of the cases collected by the writer, men were afflicted about twice as frequently as women.

The youngest patient was 28 years old, the average age, however, being from the fiftieth to sixtieth year. Many more cases occur between these years than between the thirtieth and fiftieth.

Tracheal cancer assumes a number of different forms.

Langhans (90), who in 1871 was the first to describe a primary cancer of the trachea, also first described the infiltrative form of tracheal carcinoma. His patient, a man aged 40 years, had suffered for years with symptoms pointing to a stenosis of the right bronchus. The true condition was not, however, determined during life. At the autopsy the lungs were found normal, the bronchial glands enlarged and melanotic. A swelling was found in the lower part of the trachea, extending upwards for about 4 cm. from the bifurcation. There were also nodules at the bifurcation, extending into the right bronchus for a distance of 2½ cm. The bronchus itself was narrowed by a number of warty-like elevations attached to its walls.

M. Mackenzie (91) has reported one case, also discovered at autopsy. In the trachea of this patient, a woman aged 57 years, an ulcerated growth occupying the middle third of the trachea was found. On microscopic examination the growth was found to be an epithelial cancer.

In Schrötter's case (92), a man, aged 58 years, a tracheotomy was performed. At autopsy a nodular mass was found in the trachea, extending from the first to the ninth rings. A microscopic diagnosis of carcinoma fibrosum was made.

Oestreich (100) observed in v. Leyden's clinic a primary carcinoma in the trachea of a woman aged 28 years, the youngest patient on record.

Another case of carcinoma at the tracheal bifurcation was reported by Ehlich (101), in a man aged 65 years.

Koschier (102) has reported two cases (cylindroma), both attached to the anterior wall, and another case (103) in a woman aged 40 years, in whose case a carcinoma was removed per vias naturales with a specially constructed sharp spoon of Störk.

Other authentic cases have been reported by Hoffman (106), Delafield (89), Gibb (93), Klebs (95), Reiche (98), Fischer (99), Boschi (105), Körner (109), Pick (111), Hinterstoisser (112), Schmidt (113), Pogresinsky (110) and Sabourin (109).

The writer would add still another case of his own to this list. The patient, a man 58 years of age, presented himself for the relief of urgent dyspnea. With the laryngeal mirror, a mass could be seen filling the upper part of the trachea and extending to the subglottic region of the larynx. A tracheotomy was performed with cocain. No other operation could be performed, because there was already involvement of the glands of the neck. The patient lived about four weeks after the operation. A microscopic diagnosis of carcinoma was made.

In Boschi's case, a man aged 60 years, a tumor extending from the bifurcation 5 cm. upwards was found. It extended through the trachea and was attached anteriorly to the posterior wall of the ascending aorta as well as to the arch.

In all, I could find records of twenty-seven cases, making, with my own case, twenty-eight cases.

The favorite seats for primary tracheal cancer are the upper parts of the trachea, and the lower parts close to the bifurcation. The middle third is rarely involved.

In the majority of the cases the posterior wall is involved, while the anterior wall is not so frequently implicated.

The writer has considered only cases of primary tracheal carcinoma. No mention will be made of cancer secondary to laryngeal or esophageal cancer.

Carcinoma of the thyroid gland also frequently infiltrates the tracheal wall.

SARCOMATA.

Only primary sarcomata will be considered. In three cases, however, those of Jurasz (131), Pieniazek (128) and Wright (130), the larynx was also involved, but as this involvement was just about at the dividing point the origin of the tumor was probably in the trachea.

Although primary tracheal sarcoma is rarer than carcinoma, we have been able to collect eighteen cases from the literature.

They have been reported by Schrötter (115, 116), O. Chiari (118), Levi (119), Prota (120), Heyninx (121), Killian (122), Gleitsmann (123), Schrötter (124), Labus (125), Johnston-Cottrill (126), Bamberger-Billroth (127), Schech (129), Pieniazek (128), Wright (130), Jurasz (131) and Mayer-Hüni (132).

In seven cases endotracheal operations were performed.

Of these, one of Schrötter's cases (116), lived twenty years, with many recurrences. Gleitsmann's case, which I will describe more fully later on, lived nearly two years, with a recurrence in about fifteen months.

In Heyninx's case (121), in which a myxosarcoma was removed from the trachea of a woman, aged 41 years, with the hot loop, I could find no record of the final result.

In three cases no recurrence could be detected after a short period, cases of Labus (125), Johnston-Cottrill (126) and Schech (129).

Of the cases operated on by tracheo-fissure, the final result is known only in a few. In Mayer-Hüni's (132) and Wright's (130) cases, no recurrence took place for a considerable period. In Jurasz's case (131) a slowly growing recurrence was noticed after two years.

Prota (120) has reported two cases, both in women between 40 and 50, in whom the growth was situated high up in the trachea.

Gleitsmann (123) has reported one of the few cases of tracheal sarcoma operated upon endotracheally.

The tumor in his case, that of a man aged 52 years, was situated in the upper part of the trachea and nearly filled its lumen. It was as large as a small walnut. The tumor was removed endotracheally with the Schech canula, iridoplatinum wire, devised by Gleitsmann in 1894, being used. The growth was brought through the glottis without difficulty.

There was no recurrence for about fifteen months. The further history of the case which Dr. Gleitsmann kindly sent me is as follows: In March, 1903 (the first operation was performed in December, 1901), a small tumor reappeared below the anterior commissure and was removed with the snare as before. During the following month (April, 1903) the ventricular band became infiltrated, pain, fever and aphonia developed, and at the last examination, May 9, 1903, the left half of the larynx did not move freely, and in the trachea small nodules could be seen below the anterior commissure and below the left vocal cord. A radical operation which was recommended was declined, and the patient was not seen again by Dr. Gleitsmann. He died some time in 1903.

This case teaches a valuable lesson. It proves the fact that endotracheal operations for malignant neoplasms offer very little chance of success. I have not been able to find records of any cases in which a case remained permanently cured after an endotracheal operation. In the three cases before mentioned, those of Labus, Schech and Johnston-Cottrill, the statement was made that a cure was obtained after a "short period."

Both sexes seem to be equally afflicted with tracheal sarcoma and young rather more frequently than persons more advanced in years.

As a rule, tracheal sarcomata are attached to the tracheal wall by a broad base, and have a smooth surface. Occasionally they are pedunculated. They often reach a considerable size and almost completely fill the tracheal lumen.

For the sake of completeness, I will give brief abstracts of two other tracheal tumors, reported by Johanni (134) and Henrici (135).

The tumor in Johanni's case filled the lower part of the larynx and upper part of the trachea, in a woman aged 66 years, and finally caused her death. An exact histologic examination is given. It was called an amyloid tumor.

In Henrici's case a tumor was present in the trachea of a man aged 61 years, who had suffered from "asthma" for fifteen or twenty years. It was situated on the posterior wall at the level of the third ring. A tracheo-fissure was made, and the tumor, which was 2.5 cm. long and covered with a smooth intact mucous membrane, was removed. Patient died suddenly two months after operation.

The classification of the tumor could not be determined by the microscopic examination.

A review of the recorded cases of intratracheal tumors brings out some interesting points.

Of the benign growths, papillomata occur most frequently, and of the malignant, carcinomata are most frequently observed.

The following table shows the order of frequency, with the number of each variety of tumor collected by the writer. This number could undoubtedly be added to materially, but it comprises most of the authentic cases on record to date.

Benign: Papillomata, 25 cases; fibromata (fibrous polypi), 24 cases; ecchondromata and chondro-osteomata, 17 cases intratracheal strumas, 10 cases; adenomata, 7 cases; lipomata, 3 cases; lymphomata, 2 cases; amyloid tumor, 1 case.

Malignant: Carcinomata 28 cases, sarcomata 18 cases, making in all 135 cases, 89 of which are benign and 46 malignant.

A study of the cases shows also that tracheal tumors are situated, in the majority of the cases, in the upper part of the trachea, and less frequently in the lower part. They most rarely occur in the middle of the trachea. They are attached most frequently to the posterior wall, which is rich in mucous glands. This is particularly true of the carcinomata, which appear to take their origin from these mucous glands.

Some other interesting facts are brought out by a consideration of the reported cases of tracheal tumors.

In the first place, their great rarity. The 135 cases collected by the writer represent nearly all the authentic cases recorded during the past seventy-five years. The majority of the cases have been reported, of course, since the first one observed with the laryngoscope in 1861.

The rarity of tracheal tumors becomes much more striking when the 89 benign and 46 malignant tracheal tumors are compared to the 10,747 benign and 1,550 malignant laryngeal tumors, which Semon collected between 1862 and 1888.

The malignant tumors of the larynx represent only about 12½ per cent of the total number, while in the trachea, according to the cases collected by the writer, they represent about 34 per cent of the total number. These figures are significant, because they show that a strong suspicion of malignancy must always attach to a tracheal tumor.

ETIOLOGY.

Very little is known in regard to the etiology of most tracheal tumors, and writers as a rule barely mention it. In considering the etiology of tracheal new growths, etiologic factors such as congenital displacement of tissue, predisposition and a general specific diathesis of the system are of importance.

The fact that the trachea is not more often the seat of new growths may be explained by its protected position and its somewhat passive function. It is not easily subjected to mechanical or chemical irritation.

Granulation tumors originating after tracheotomies were not considered in the writer's paper, because they are not true new growths. A chronic inflammation of the tracheal mucous membrane probably plays an important role in the development of neoplasms. An inflammatory process, in conjunction with pulmonary tuberculosis, seems to have an important etiologic bearing on the development of cartilaginous and bony formations. There is no apparent reason for this, however.

The etiology of intratracheal struma, which has been well worked out, has already been considered in this paper.

SYMPTOMS.

As the main symptoms of all tracheal growths are those produced by the resulting stenosis, and as we are to have an exhaustive paper on this subject, I will not mention symptoms directly caused by stenosis at all.

There are a few symptoms, however, which can be attributed to the tumors themselves. Tumors in the trachea may be present for years without causing any special symptoms, and it is surprising that even large ones sometimes cause so little disturbance.

A case has been reported by Siegert (22), in which a papilloma as large as a pigeon egg was situated at the tracheal bifurcation, and did not cause any particular difficulty in breathing. This patient, a man 54 years old, died of general septicema following an infection of a wound, and the tumor in the trachea was found at autopsy.

In one of Schrötter's cases (115), the patient lived many years with a sarcoma that almost completely filled the tracheal lumen.

In some cases attacks of suffocation come on only periodically. This was so in a case reported by Fifield (57), in which a fibroid polyp as large as a berry, covering the opening of the left bronchus, was found at autopsy.

The character of the dyspnea varies according to whether the growth is pedunculated and freely movable or not: A movable growth acts like a valve, so that at times there will be an inspiratory dyspnea and at other times an expiratory dyspnea.

Gerhardt claims that a bending forward of the head is a symptom that is always present in tracheal obstruction, while in laryngeal stenosis the head is bent backwards.

The voice, as a rule, is not affected, except when growths with long pedicles are situated high up in the trachea, and are carried to the glottis by the air currnet. In such cases some hoarseness may be present without much dyspnea. Masini (62) and Jurasz (68) both observed cases of this kind.

The voice may be also affected by an involvement of the recurrent laryngeal in cases of tracheal carcinoma. Such observations have been made by Hinterstoisser (112) and Oestreich (107).

Secondary symptoms are also produced, particularly by slowly growing tumors. Occasionally, diffuse bronchiectasis, empyema and atelectasis are produced in certain portions of the lungs. Catarrhal bronchitis and lobular pneumonia are also sometimes complications.

Körner (109) has reported a case in which carcinoma in the lower part of the trachea encroached upon the right bronchus, and produced an obstructive atelectasis of the whole right lung.

DIAGNOSIS.

When the characteristic symptoms are present it is usually quite easy to make a diagnosis of some tracheal obstruction, although without direct inspection it would be hard to determine whether the obstruction is caused by a tumor, a stricture or a foreign body. The diagnosis of a tracheal stenosis, the most common symptom of intratracheal growths, is of course simple. It must be determined, however, whether the cause is in the trachea itself or from external pressure.

An examination of the upper part of the trachea, except in young children, can usually be made with the ordinary laryngeal mirror, after cocainization, in some cases without it.

Laryngoscopy can, however, be quite easily practiced even in young children if they are given a little chloroform or somnoform. A forehead lamp or a self-illuminating mirror is most convenient.

For laryngoscopy under an anesthetic, a loop of silk worm gut may be passed through the tongue, as recommended by Jackson (*Laryngoscope*, April, 1905). it will not cause as much soreness as a tongue forceps. The Kirstein spatula is also of service for diagnosticating tumors in the upper part of the trachea, and in children can be used just as well under general anesthesia. A good inspection of the trachea in adults may often be obtained, if the patient is examined while standing, according to Killian's method. In six of the seven cases of tracheal tumors operated upon by Bruns, he was able to make the diagnosis with the ordinary mirror. After cocainization, much can be learned in regard to the nature of the growth with an extra long laryngeal probe. Instead of employing Kirstein's autoscopy, a Grant epiglottic lifter may be applied, with the patient in Rosen's position, and the upper part of the trachea inspected in this way.

An X-ray examination will at times show the presence of tumors that cannot be easily inspected and is a great aid in the diagnosis. For tumors below the middle of the trachea, Killian's tracheoscopy or bronchoscopy would be of service if the tumor cannot be inspected in any other way.

As the methods of performing tracheoscopy, as well as the improvements of Ingals, Jackson and others in instruments and methods of lighting the deeper parts of the trachea and bronchi are so well known, I will not mention them here.

As an operation would have to be performed in any event, it is best to perform tracheotomy when symptoms become urgent and make the diagnosis and perform the operation for the removal of the growth at the same time, rather than to subject the patient to a preliminary bronchoscopy or tracheoscopy. After tracheotomy an excellent inspection of the lower part of the trachea may be obtained through the ordinary Kelly cystoscope, after passing it through the tracheal wound. An ordinary head mirror can be used in throwing light through the cystoscope. Small benign tumors may be removed through the cystoscope with forceps, particularly if a large cystoscope is used.

The fibroma or fibrous polyp is usually pedunculated, and Schrötter (114) has reported a case of a distinctly pedunculated sarcoma which was freely movable.

In Pröbsting's case (132) an apparent polyp with a long pedicle which had been coughed out was found to be carcinomatous. The intratracheal struma has been fully considered.

It is often difficult to make a differential diagnosis between carcinoma and sarcoma.

It was found in a study of the cases that carcinoma occurs more frequently, particularly in men of advanced years. When metastases, which are rare in primary tracheal carcinoma, occur in the lymphatic glands of the neck or in the larynx, esophagus or bronchi there is no doubt about the diagnosis.

Sarcoma usually occurs as a growth with a broad base and smooth surface. It grows slowly, sometimes becoming very extensive, however, and shows little tendency to ulceration.

Carcinoma shows a greater tendency to ulceration and is usually more irregular in outline.

The tracheal papilloma can as a rule be recognized by its appearance, particularly when it occurs in children; it is also present at the same time in the larynx.

Schrötter (113) has described a tracheal carcinoma occurring in the form of papillomatous excrescences. Wright (129) has also described sarcoma simulating papilloma.

PROGNOSIS.

The prognosis of tracheal neoplasms, unless some operative measures are promptly carried out, may be said to be almost absolutely unfavorable, because without operation, the stenosis caused by the tumor becomes greater all the time, and the patient may suddenly die of asphyxia even before a tracheotomy can be performed. The higher up in the trachea the tumor is situated the more favorable the prognosis, because it can not only be more easily reached during operations, but if tracheotomy becomes necessary, the canula can be introduced below the tumor.

When tumors are present low down in the trachea near the bifurcation a tracheotomy, without at the same time a removal of the growth, may not do much good, because it would be difficult to get the end of the canula below the growth. The fibromata, particularly the pedunculated polypi, according to all authorities, give the most favorable prognosis, because they usually occur singly, and do not show a tendency to recur when removed.

Lemoine (7) states that in twenty-six cases of benign tracheal growths collected by him, cures were obtained by operations in ten out of fourteen patients; of twelve not operated upon, ten died.

The prognosis of the intratracheal strumas is also favorable, as their growth is very slow and they apparently do not readily recur after removal. In the writer's case before mentioned, removed by tracheo-fissure, there has been no recurrence since the operation was performed in 1901.

The papillomata are not so favorable, because they are usually multiple, often recurring simultaneously in the larynx and trachea, and show a decided tendency to recur after removal.

Among the cases collected, the endotracheal removal was performed in eight, in all of which the growths were situated in the upper part of the trachea. There were recurrences in a number of these cases.

In four cases, all children, laryngo-tracheo-fissure was performed in order to remove at the same time the laryngeal and tracheal growths. A number of these cases subsequently died of recurrences. The carcinomata offer the most unfavorable prognosis of all. Statistics show that patients afflicted with tracheal carcinoma live as a rule only a few months, although they may live several years. Death usually results through slow suffocation, pneumonia or metastases to neighboring organs.

On the other hand, observations are on record to show that at times the disease remains localized for a very long period. Tracheotomy does not seem to prolong life much in these cases, but if the canula can be applied below the growth, it certainly makes the patient's death easier. Schrötter (114) has reported a case in which it was not possible to get in the canula.

From the fact that some cases of tracheal carcinoma develop so slowly, and show no tendency to metastasis, it does not seem too much to hope for, that in the near future a radical operation such as a resection of the trachea will be performed more frequently and just as brilliant results obtained as in early laryngectomy for laryngeal cancer. I have been able to find only one case in the literature in which a resection of the trachea for carcinoma was performed. This case was reported by Bruns (103). His patient lived six years after the operation. Koschier (101) has reported a case in which a carcinoma (cylindroma) was removed by tracheotomy, and six months later no trace of a recurrence could be dectected. In tracheal sarcoma the prognosis does not appear to be extremely unfavorable. Data are lacking in regard to recurrences of tracheal sarcoma after removal. In fact, practically nothing is known about it. In Gleitsmann's case of the endotracheal removal of a sarcoma, there was no recurrence for about fifteen months, but soon after that the tumor did recur.

The growth of sarcoma in the trachea is very slow, the disease often extending over a period of years. Nor does the growth show any tendency to ulceration or extension to the surrounding structures.

Of the seven endotracheal operations on record, for tracheal sarcoma, three cases were reported cured, although there is no record to show that they remained cured. These three cases were called cured because there was no recurrence in four or five months. In one case there was a recurrence, but the patient lived many years, and one case rapidly terminated fatally. Another patient (Gleitsmann's) lived nearly two years after the operation.

The growths in five cases were removed by tracheotomy, and in two there had been no recurrence after three months and one year. In one case there was a recurrence after two years. In two cases tracheotomy was followed by a fatal issue.

TREATMENT.

The treatment of the large majority of the cases of tracheal tumors may be summed up in the one word, operative. Palliative measures may be used when growths are so small that they do not interfere to any extent with breathing, but it must be remembered that a good many of the tracheal growths have a fairly rapid growth, so that it is safer to remove even small growths as soon as the diagnosis is made.

Tracheotomy performed for the purpose of relieving breathing comes under the head of palliative measures, and is successful if the canula can be inserted below the growth.

As statistics show that in over one-half of all cases, tracheal neoplasms are situated in the upper third of the trachea, a low tracheotomy would relieve the patient's breathing in a majority of the cases. In cases in which the tumor is situated very low down in the trachea, a piece of a rubber stomach tube may be used in case of emergency, if a long tracheal canula will not reach below the growth. In such cases, if the patient's condition permits it, it would be wise to attempt the removal of the growth as soon as free respiration is established. Other conditions sometimes make tracheotomy difficult and even impossible.

The patient died in one of Schrötter's cases (111) while he was attempting to perform tracheotomy. The lumen of the trachea was so filled with the growth (carcinoma) that the canula could not be inserted.

In inoperable cases, a tracheotomy will have to be performed in any event, and in operable cases it not only prepares the way for a thorough inspection of the trachea, either with the finger or through a tube, but it is at times a necessary preliminary step to an endotracheal operation.

Endotracheal Operations.—Operations through the mouth should be performed only for small pedunculated benign growths, situated high up in the trachea. Endotracheal operations for malignant growths do not offer a much better chance of success than endolaryngeal operations for laryngeal cancer. They should not be attempted. Statistics in regard to the recurrence of tracheal sarcoma after endotracheal removal are sadly deficient.

The results of the seven endotracheal operations for sarcoma, as well as those removed by tracheo-fissure, have already been given. The most favorable tumors for removal through the mouth are the papillomata, and about a dozen such operations have been performed—a majority of all endotracheal operations.

The technic is the same, except that longer instruments have to be used, as for the laryngeal operations.

Children can be operated upon under general anesthesia, with the aid of the Kirstein spatula.

The removal of a tracheal tumor by tracheotomy, or better tracheo-fissure, is the operation of choice for the majority of the cases. Benign neoplasms of all kinds can be readily and radically removed in this way, and there is much less chance for recurrence than when they are incompletely removed through the mouth. This is particularly true of the five cases of intratracheal struma (4 of Bruns' and the writer's case), in which there have been no recurrences after radical operations (tracheo-fissure). There are about twenty such operations for different tracheal growths on record.

Mayer-Hüni (132) removed in this way a sarcoma situated just above the bifurcation.

In performing these operations, the anterior wall of the trachea should be split for a considerable distance, so as to give the operator plenty of room. Either a tampon-canula can be used or the operation can be performed in some cases of benign growth without it, with the patient in the Trendelenburg position.

Resection of the trachea has only been performed in one case, that of Bruns' (104), before alluded to.

He removed a carcinoma of the posterior tracheal wall, including the posterior wall and ten of the rings, keeping the patient alive for six years.

After tracheotomy, small tumors low down in the trachea may at times be removed through a cystoscope under direct inspection.

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L.

STENOSES OF THE TRACHEA.*

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In speaking on that portion of the subject allotted me, namely, Stenoses of the Trachea, and to keep well within sequence with the other papers forming this discussion, one is confronted with two very important considerations: First, whether the morbid processes causing the stenoses originate within and confine themselves to the trachea itself—that is, are not an extension of the larynx above or the bronchi below; and, secondly, whether the stenosis is due to conditions arising within the trachea or to compression of the trachea from without.

Stenosis arising within the larynx and continuing to the subglottic portion and the trachea below was well and thoroughly considered in detail at the 1905 meeting of this Association by Dr. John Rodgers, and need not be considered here. (1) So my remarks will pertain more especially to stenoses confined to the trachea itself, realizing, however, the difficulty of such an absolute limitation.

Causes.—For the purpose of a more thorough discussion, causes of tracheal stenosis may be divided into extrinsic and intrinsic, the extrinsic variety including that form known as compression of the trachea; and it sometimes follows in this relation that causes which originate without, may, by extension of the lesion, incorporate the tracheal lumen and thus develop an additional or true tracheal stenosis. This is probably seen to happen more in malignant disease than in other forms of external causes, and, further, various external causes, such as aneurisms, abscesses and suppurating glands, may—after a period of pressure—rupture and discharge their contents into the trachea, causing often an acute fatal termination. Among the extrinsic causes may be mentioned:

1. Struma, which, according to Chiari, is the most common of external causes (2).

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2. Pressure by various tumors, whether benign or malignant.
3. Glandular hypertrophies, including tubercular, and the various phases of goitre. Thymus hypertrophy in the opinion of Riegel and others (3), though it may (though rarely) cause compression stenosis, shows the effects of compression mainly on the vascular and nervous trunks.
4. Pressure by emphysema, either traumatic or extending from pulmonary disease below.
5. Aneurisms, either from the aorta below or from the lateral cervical vessels.
6. Diffuse or localized phlegmonous cellular inflammations of the neck, with or without the production of abscess.
7. Extension of bone disease from sternum, clavicle and vertebral column (4).
8. Traumatisms, including fractures, ruptures, cutthroat, strangulations, etc.

Mediastinal diseases, though giving rise to pressure on the primitive bronchi, are not regarded by Riegel (5) as frequent causes of tracheal pressure; if so, the compression is not very great.

Chiari (6) mentions an occasional cause called struma ventosa; i. e., accumulation of air in the region of the upper portion of the thorax, after injuries of the large air passages.

The character, intensity and difficulty of determining the various external causes depend on the location of the compression factor—those from deep within the tissues of the neck, those posteriorly situated and those arising from below being the most difficult in point of determination and relief; while those more external in their nature and laterally situated offer the most easy solution from all points of view.

Frequently, from long continued lateral pressure, the trachea may be deflected from its median position in part or in the whole of its entire length, which fact must be borne in mind, as it often adds greatly to the difficulty in operative procedure for relief.

Intrinsic causes may be conveniently classed as being due to:

1. Cicatrices and adhesions.

2. Morbid growths and foreign bodies.
3. Inhalation of smoke, flame, volatile fumes; ingestion of corrosive chemicals and acids.
4. Inflammations, thickening of tracheal walls.

According to Chiari (7) intratracheal stenosis is much more rare than that from external causes, but when it does exist it involves a greater extent of tracheal lumen. The form and severity depends essentially on the causative factor, no two cases seeming to be alike in detail of stricture formation, which makes it a most interesting study in reviewing the many reports of isolated cases and which bears greatly on the individual ingenuity in the way of treatment.

Under the first heading, tertiary syphilis and secondary stricture from tracheotomy are undoubtedly the most common causes, the cicatrization and contraction of the syphilitic ulcer following the same law in destructive deformity as seen so commonly in the larynx and pharynx above. Though generally irregular in shape, certain cases show a distinct annular formation with a comparatively uniform stenotic aperture.

Although ulcerations from glanders, diphtheria, typhoid fever, tuberculosis and even so-called catarrhal ulcerations, have been reported as producing tracheal strictures, the instances are but exceptional. In this relation I may mention the extensive and interesting account by Schrötter (8), with detail of treatment and illustrations, of a case of primary tracheal tuberculosis producing stricture. He goes deeply into the subject and offers many conclusions worth reading.

The irritation from a long-continued wearing of a tracheal canula, from whatever cause it may have been originally introduced, frequently produces a secondary stricture along the various parts of contact, and this liability must always be given thought when tracheotomy is performed, and every effort made to dispense with the canula as soon as possible, especially if originally introduced as a temporary procedure; and a choice of size and shape of canula should be made which will have the least tendency to these after-pressure effects. Though occurring at either extremity of the canula, the most frequent location of secondary stricture is at the upper end, about and above the orifice of the tracheal opening, where granulations may form which subsequently may become very dense and on attempt at removal of canula may fall down in the trachea, thus necessitating the constant re-introduction of the tracheal tube to prevent suffocation. The granulations may take on the character of the original cause for which the tracheotomy was performed, especially if for malignancy or papilloma; or there may be formed hard, firm, contracting granulation tissue, due to pressure effect and independent of any diseased condition. This contraction becomes very marked in some instances, completely shutting off any connection with the larynx above. This condition offers one of the most difficult factors in attempts at restoration of the tracheal lumen by dilatation.

Tracheotomy may also produce an inverting of the tracheal rings, and also tracheal defects from pressure absorption with subsequent strictures at these points. The tendency of these after-effects depends greatly on the diseased conditions of the mucous membrane producing the original cause of the stenosis.

Strictures from intratracheal growths and foreign bodies will be duly considered under the portion of the discussion allotted to those subjects, and need no mention here.

Strictures resulting from inhalation of smoke or flame, scalds, volatile fumes, the ingestion of corrosive chemicals and acids sometimes occur, and in some instances the resultant damage may be more or less limited to the trachea, but as a rule there is a general involvement of the contiguous passages. These accidents are naturally of a severe type and are apt to prove fatal in the initial inflammation.

Strictures from primary or inflammatory thickening, or hypertrophy of the tracheal walls, may arise from other ulcerations, edema, acute or chronic inflammatory swellings, perichondritis, abscesses or scleroma.

Symptoms.—Although cough, change in character of voice, sense of irritation or uncomfortable suffocative sensations about the throat may lead to suspicion of tracheal implication, the chief symptom is interference with breathing which, when excessive, becomes stridulous in character—the stridor indicating mechanical obstruction of larynx or trachea. The voice is not very characteristic. It may be faint or of a muffled character, though perhaps with some effort in phonation, but it generally remains clear, following the law of subglottic stenosis as compared with the various types of hoarseness indicating laryngeal involvement.

Tracheal dyspnea has some characteristics peculiar to itself. It is inspiratory in character, the inspiration being longer than expiration. It may be of a noisy, labored, wheezing nature; becomes at times audible at a considerable distance, but it has not the peculiar brassy, croupy, stridulous sound of laryngeal dyspnea. The wheezing sound may sometimes be felt as a thrill.

In tracheal stenosis, the motion of the larynx remains almost stationary, being quite in contrast to laryngeal stricture, where the larynx makes profound excursions up and down in efforts at breathing. The phenomenon was first pointed out and emphasized by Gerhardt (9), (10).

During the preparation of this discussion, the writer has had the opportunity of observing this phenomenon as it concerns the larynx, to a marked degree, in the case of a patient with a bilateral abductor paralysis, who in all efforts to breathe would cause the larynx to make most prolonged and violent excursions. Whether the character of the laryngeal obstruction causes any accentuation of this phenomenon, I am unable to say. Gerhardt also pointed out the fact that in tracheal stenosis the head is either kept in the upright position or bent forward; while in laryngeal dyspnea the head is thrown back. My observations have been that the tendency to the forward bending of the head becomes more prominent the lower the stenosis is in the trachea, reaching its fullest bending in bronchial stenosis or spasms, as seen in the position of the asthmatic patient.

Auscultation of the chest is only of importance as distinguishing tracheal stenosis from unilateral bronchial stenosis, in that in the latter instance the vesicular murmur is absent or diminished on the side affected; but if there be bilateral absence of murmur, the stenosis may be in either the trachea or located at the bifurcation.

Demme (11) alludes to the fact that in long-standing tracheal stenosis the circumference of the upper portion of the thorax is diminished in measurement.

While the above phenomena include the salient features of tracheal stenotic symptoms, subjective and objective, there may be other associated symptoms, as for instance, the frequency of changes in pulse rate and distension of cervical veins, depending on the degree of external pressure and the implication of the pneumogastric nerve. Paroxysmal attacks of suffocation may supervene, but they are not so constant a factor as in laryngeal stenosis.

Aufrecht (12) reports a new symptom of tracheal stenosis. In three cases of stenosis of the trachea, the author was able to observe a symptom which had not been as yet described in this connection. When the stethoscope is applied to the trachea, immediately above the sternum, the very rough bronchial breathing which in the normal condition is invariably perceptible during the entire time of inspiration and expiration, was found to be replaced by a short, low, soft breathing, or was entirely inaudible. The detail for the reasons is fully described in the article.

We are greatly indebted to Gerhardt (13) for the most complete exposition of tracheal stenosis, and I quote from him in his attempt to formulate its stages, of which he recognies three.

"1st. Almost entirely free from disturbance, labored respiration coming on only upon physical exertion.

2nd. A stage of continuous and well marked stenosis which may extend over a great length of time, and which presents almost all the symptoms occurring in stenosis of the larynx, especially the audible respiration sounds, the form of respiration and its relative prolongation. The voice of the patient is weak in this stage and of limited volume.

3rd. Is apt to appear very rapidly. It commences with a paroxysm of suffocation which soon passes over and from which the patient apparently recovers. Nevertheless, the paroxysm recurs after a shorter or longer interval, and the patient either dies in this paroxysm or succumbs to a rapidly extending pneumonia of respiration."

Riegel very truly comments that although every case of tracheal stenosis by no means passes through these three stages in the order given, still this may be regarded as the normal course in the majority of cases.

Diagnosis.—Though the symptoms above enumerated direct our attention at once to the trachea, it is fortunate that we are not entirely dependent upon these subjective symptoms in order to substantiate our diagnosis, for we have at our command facilities for examination which, in practically all cases, make the diagnosis a matter of certainty. It goes without saying that any decided external manifestation of pressure will at once account for the stenotic symptoms. When these manifestations are not present, we have the use of the laryngeal mirror, which, in nearly all instances, will bring the entire tract under view and will at once give us the extent of laryngeal involvement in its association with the trachea.

The X-ray is most invaluable, especially as to accurately locating dense tumors and foreign bodies, and bronchoscopy, as at present perfected, leaves little to remain in the way of perfecting our information. One thing must always be remembered, which undoubtedly has been the experience of us all, that, in depending upon the laryngeal mirror, we have always found on operation a greater extent of stenosis than the picture of the laryngoscope seemed to indicate. This is especially so in malignant cases.

Treatment.—Perhaps in no other condition can we better employ the broad saying that the first element of treatment depends on the recognition of the cause. Especially is this so as it pertains to the external compression type of cases—where the proper surgical treatment, serum or glandular therapy at once suggest themselves. This same axiom applies to the removal of the intratracheal growths and foreign bodies; and if syphilis be the cause, the administration of potassium iodid and mercury.

But in a certain number of cases, those of pure internal strictures, treatment must be directed to the relief or eradication of the stricture itself. For this purpose we have at command tracheotomy, tracheal fissure, with exsection of the stricture tissue, resection of that portion of the trachea which includes the stricture, and, finally, the various forms of dilatation.

Tracheotomy as a sole measure should only be resorted to when it is conclusive that no other surgical means can be employed. It must, however, be used in a large proportion of cases as a life-saving measure in cases of emergency, and as a preliminary measure to dilatation when the stricture cannot be reached through the larynx—and under these circumstances should be made as high up as the nature of the stricture will allow.

It sometimes occurs that the extent and deep location of the stricture is determined only when tracheotomy has been performed for the relief of dyspnea and we find that the operation has been unsuccessful. In these cases it becomes necessary to supplement the tracheotomy by the passing down of long flexible catheters through the tracheotomy tube in order to produce the desired effect. These cases are in their nature very extreme in type and subsequently prove fatal. I have, though, seen such instances, one (14) a case of deep aneurism pressing on the trachea at the bifurcation; and another, unpublished, due to a chain of deep cancerous glands, alternately pressing on the trachea, in which the urgent dyspnea was almost the first indication of their presence.

Resection of the stricture tissue itself may sometimes be possible in suitably situated or limited cases, either through fissure of the trachea or by means of the bronchoscope, subsequent dilatation being necessary for permanent cure.

Resection of the trachea is advocated by O. Frankenberger (15) as the only radical treatment for all strumous stenoses and all chronic stenoses, which include but a limited portion of the trachea, and he reports two successful cases as done by Küster.

It is the general consensus of opinion that the best treatment of internal tracheal stricture is by some form of dilatation, and I think we can say without contradiction that the best method is that based on the principles of O'Dwyer's form of intubation. If the stricture be not very high up in the trachea, it may be possible to produce dilatation through the larynx by intubation without tracheotomy, but in the vast majority of cases of tracheal stricture it becomes necessary to do a preliminary tracheotomy in order to carry out subsequent dilatation. If it be elected to use intubation after tracheotomy, the tracheotomy should be performed as high up as possible, so that the end of the intubation tube can pass below the tracheotomy opening as far as possible in order to be better retained. If we find that the intubation tube cannot be well retained, then the retention device of Dr. John Rodgers, reported by the writer, may be used (16).

Intubation, either with or without tracheotomy, is better indicated for long and sustained periods of dilatation. The hard rubber form of tubes will meet with all requirements, and are, I think, generally speaking, better than metal. It may be necessary to do some form of preliminary stretching of the stricture before the full value of intubation can be obtained. I think we should always endeavor, as far as possible, to employ the permanent method of intubation where it can be accomplished. In a certain number of cases, intubation by O'Dwyer's method may be impracticable—in those instances we have the well-known methods of Schrötter, and the glass chimney canulas, as first introduced by Mikulicz, the details of which are fully described by Kümmell (17). Soft rubber chimney canulas, to meet certain conditions, are also described by the same writer.

Schmieder, in a detailed and illustrated article (18), refers to the use of Dupuis' chimney canula, Schroeter's wedges, Thost's wedge canula and a chimney canula proposed by Schimmelbasch, and successfully used in Bergmann's clinics; also to a long canula in the shape of a horizontal T. These various forms are intended to meet various peculiarities of strictures which may arise. Schmieder emphasizes the necessity of the early use of these dilating measures in order to save the more extensive future operation of exsection, etc.

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LI.

FOREIGN BODIES IN THE TRACHEA AND TRACHEOSCOPY.*

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The proper treatment of a case in which a foreign body has been inhaled into the trachea has been discussed periodically in medical literature for a century. A very large number of cases have been reported, the foreign bodies including an enormous variety of objects. The symptoms offer almost as much variety, from instant death to practically no symptoms at all. The diagnosis of a foreign body in the trachea or bronchus is not always easy. The history may be misleading. If it is in the trachea, it seldom remains long in one place. There is generally much respiratory irritation, cough, spasm of the glottis, sometimes a rattle as it moves up and down. It seldom stays long in the trachea, it is either expelled or drawn into a bronchus. If in a bronchus, there may or may not be dyspnea, cough, pain in different parts of the chest, either constant or periodic. The foreign body, unless it obstructs the passage of air, may produce little or no irritation, but will ultimately cause local infection and consequent symptoms.

The diagnosis may be made positively by inspection with the bronchoscope, or if it is an inorganic substance by the X-ray, or it may be made probable by physical signs.

The prognosis, if a foreign body has been inhaled, depends upon the nature of the body, the condition of the patient and the possibility of proper treatment. The nature of the body will determine the distance that it can penetrate into the bronchial tubes, the amount of trauma or sepsis which it will cause and the ease with which it can be detected and removed. The condition of the patient may be seriously affected if air has been cut off from any part of the lungs, if much irritation be produced or if there is serious sepsis. On the other hand, foreign bodies have not infrequently remained for months or even years in the air passages, and have finally been expelled or removed, but they almost always cause or keep up more or less infection, which either slowly weakens the patient or by an exacerbation becomes fatal. When the foreign body is expelled or removed, the patient, unless in a very serious condition at the time, generally entirely recovers.

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*Read before the American Laryngological Association May, 1906.

The important questions for the responsible physician, after considering the nature of the foreign body, its probable position and the condition of the patient, must always be, first, what is the danger of leaving it alone; second, is the patient's chance better or worse if an attempt is made to reach and remove it by operating, and, third, what operation shall be done. While the answer to the last two questions has, I think, materially changed within the last few years, the answer to the first, what is the danger of leaving it, is the same as it has always been.

To review this question briefly, I will quote from a few monographs in which the writers have collected statistics from series of reported cases. Roe, in 1893, found that the mortality in the cases which he collected was about 30 per cent where no operation had been done.

The writer justly says that statistics are misleading if we do not take into consideration the various conditions affecting them. A number of cases in which seeds or other small objects are inhaled and subsequently expelled might or might not reach the compiler of statistics, with a consequent lowering or raising of the death rate. If we infer from reported cases that the mortality is about 30 per cent, we exclude many cases in which a small body is inhaled and subsequently expelled by coughing. Including all cases of foreign bodies inhaled into air passages collected by Durham, Gross, Weist and Roe, in which no operation was done, a total of 1,417, there was a mortality of 27 per cent.

Wood studied the pathology of foreign bodies in the lungs, both from clinical records and by experiments on animals. He collected from German and English literature, dating from 1878 to 1879, eighty-nine cases of foreign bodies entering the lung through the upper air passages, and finds a mortality of 34 per cent, a figure which agrees closely with those already quoted. From an analysis of these cases, he concludes that: where an extraneous object has entered a bronchiole through the trachea, it will be spontaneously expelled in about 57 per cent of the cases, and if this takes place the almost absolute tendency is towards recovery.

The diseases resulting from the entrance of foreign bodies into the lung through the air passages are abscess, pneumonia, bronchitis and gangrene. If the foreign body is not contaminated with especially virulent organisms, or is so formed as not to cause solution in the continuity of the mucous membrane, or does not block off the air from the lobe supplied by the bronchus in which it lies, it may be possible for it to remain in situ in the bronchus for a considerable length of time without producing any pathologic changes. The extent and malignancy of the lesions are dependent chiefly on the character and virulency of the bacteria with which the foreign body is contaminated. The shape and size play an important role, but still a secondary one to that of the microorganisms. A substance which is capable of disintegration causes much more extensive lesions than a smooth, stable substance.

The proper methods of treatment of inspired foreign bodies have, I believe, been so changed in the last few years by the introduction of direct tracheotomy and bronchoscopy, that it is unnecessary to discuss the old operations, or attempts to reach and remove the offending body. Since the endoscope of Bozzini in 1807, the introduction of endoscopy applied to different cavities of the body has been slow, and for years treated as an interesting rather than a practical proceeding. Its perfection could only be attained after the introduction of suitable illuminating devices, practical instruments and, to a less extent, anesthetics. But even after the possibility of proper apparatus it was some years before it was commonly appreciated that certain apparently crooked passages are not necessarily bars to the passage of straight instruments. The trick of sword swallowing is an old one, and is probably the source of inspiration for the esophagoscope. Bevan and Kussmaul in 1868, Mikulicz, Stoerk and Morell Mackenzie in 1881, and later many other observers, saw the interior of the esophagus, and occasionally, sometimes by mistake, entered the trachea instead.

A history of bronchoscopy would necessarily include the history of esophagoscopy, which has long been established as a practical medical procedure. Tracheoscopy and bronchoscopy may now also be said to have passed their introductory stage and to have become one of the accepted and established proceedings of medical or rather surgical practice. The credit for this is largely due to Killian. He adapted the esophagoscope to the trachea and bronchi, he made use of the work already done by von Schroetter and Pianiazek, and of the autoscope and illuminating apparatus of Kirstein, he first removed foreign bodies from the bronchi through the natural passages, and he perfected and published details of instruments and technic which made easy the way for others to follow him. The treatise by von Eicken, Killian's assistant in Freiburg, which appeared in 1903, covered the subject so completely at that time that, although I shall quote from it freely, I will refer the reader to it for a history of bronchoscopy and for many details.

The principles of tracheoscopy and bronchoscopy are very simple. They consist in straightening out certain angles or corners by means of a stiff straight tube, through which the work is done under direct inspection. There are two of these angles, the straightening of either one of which will allow direct inspection of the bronchi, one through the natural passages by passing a tube through the mouth, pharynx and larynx into the trachea, the second through an artificial opening directly into the trachea after a tracheotomy. Thus we have upper and lower bronchoscopy, which must in many respects be considered separately.

Turning to the practical value of tracheoscopy or bronchoscopy for the removal of foreign bodies which have been inhaled and impacted in the trachea or bronchi, we find that the old methods of groping blindly in the dark, often unsuccessfully and sometimes causing serious trauma, have been replaced by comparative accuracy, certainty and slight injury to the patient. Of the cases collected by Roe, combining his statistics with those of Durham, Gross and Weist, a total of 1,234 cases in which previous to the introduction of bronchoscopy operations had been done, there was a mortality of 22 per cent. On the other hand, in the reports of 50 cases which I have been able to collect of removal of foreign bodies, twenty by upper and thirty by lower bronchoscopy, the mortality was four, or 8 per cent, three of the fatal cases being in a serious condition at the time of the operation. Also, the probability of finding the foreign body by bronchoscopy, and the large chance of not recovering it after the old operations, must be considered in advising operation.

The ideal method of extracting is with the aid of upper bronchoscopy. This requires a hollow tube, proper illumination and an extracting instrument. Kirstein's autoscope made possible the direct inspection of the deep pharynx and larynx, and Killian's tube spatula made it easier to see and reach the interior of the larynx. Guided by these, Killian in 1897 passed a long tube through the glottis and trachea into a bronchus and extracted a foreign body. He then made a series of tubes of different calibres and lengths, with extracting and other accessory instruments, all of which are in common use today. The tubes are slightly bell shaped at the end, and are graduated so that the operator can see at a glance the distance to which the tube has penetrated. No stilette is used. If the trachea only is to be explored, it is seldom necessary with adults to use general anesthesia. The pharynx, epiglottis and larynx are thoroughly cocainized before the introduction of the tracheoscope, and after its introduction the trachea is also cocainized through the tube. With children or nervous adults, or in case the bronchi are to be explored, it is usually necessary to give a general anesthetic. When cocain only is used, the patient is seated on a low chair with the head thrown well back. All clothing around the neck should be removed. If under a general anesthetic, the patient is on his back with his head over the end of the table. That the passage of the tracheoscope with cocain anesthesia does not require an exceptional patient nor prohibitive skill on the part of the operator, is proved every day in different clinics, especially in Germany, where tubes are introduced as routine into the esophagus and trachea.

The tube is passed under direct inspection. This may be aided, especially when the longer tubes are used, by bringing the larynx into view with Kirstein's autoscope or Killian's tube spatula, and passing the autoscope through this. As the glottis is reached, the patient is told to take a deep breath and the tube is passed between the cords and downwards through the trachea to the bifurcation. In case it is necessary to enter one of the bronchi, this also is done after cocainization under direct inspection. For the exploration of the bronchi, the tube should be long enough to reach from the upper incisor teeth to the middle of the sternum; that is, in adults from 30 to 35 centimeters. A bronchus is capable of considerable movement or bringing into line by the bronchoscope, so that it may be searched through its primary or even its secondary divisions. In this case a perforated tube must be used, to maintain the respiration in the other bronchus. For the removal of foreign bodies from the bronchi, says Killian, a good view, great care and quietness in procedure are essential.

There have been but few modifications of Killian's bronchoscopes, and it would seem difficult to improve on them. In order to maintain respiration in the other bronchus, Ingals made a spiral series of smaller perforations instead of the larger ones of Killian. Jackson has combined the small accessory tubes and small lamp and the stilette of Einhorn's esophagoscope with Killian's tubes. The lamp I shall speak of later. The stilette will appeal to many in passing the tube into the esophagus, and even for the larynx the author quotes Ingals as preferring the sense of touch on account of experience gained in intubation. The stilette must, of course, be immediately withdrawn as soon as it reaches the interior of the larynx. When the air passages are invaded, either by a foreign body or by instruments, there may be a reflex respiratory inhibition which under certain conditions may be serious. This has been studied by Crile, who advises that a general anesthetic should not be used unnecessarily. If it is used, it is well to give a hypodermic injection of atropin to protect the circulation and to cocainize locally. In one of my cases, previously reported, the patient stopped breathing when the bronchoscope entered the left bronchus, and artificial respiration was necessary.

After the tube, the next essential is proper illumination. Much has been accomplished by a head mirror and reflected light. This is practical enough with a short tube of fairly large calibre. As it becomes longer or of smaller calibre, reflected light becomes fainter and harder to manage. The least movement on the part of the patient or the observer throws it out of adjustment. The absence of any other method of illumination might make it advisable to abandon upper and resort to lower bronchoscopy. Its greatest advantage is that it is always available and in working order. The source of light used by Killian is generally the head lamp of Kirstein. As the operator carries the light about with him it is not thrown out of adjustment by movements of the tube.

In the electroscope of Caspar, a reflecting mirror with a small hole for the observer's eye is placed just in front of the entrance to the bronchoscope. It gives a better light than the head lamp for inspection or diagnosis, but is in the way if instruments are to be passed down the tube. It requires the same electrical current as Kirstein's head lamp. A small lamp at the distal end of the tube gives an illumination which has certain advantages. This was used by Einhorn in his esophagoscope. Ingals first removed a foreign body by its use in a bronchoscope. The light is not obstructed by instruments on their passage down the tube, it dispenses with head apparatus and darkened rooms. The electrical current required is easily obtained, three or four dry cells or even ordinary wet cells such as are used for ringing door bells will suffice. It is, of course, a delicate apparatus which must be kept in order, and there is perhaps danger of breaking or losing the lamp in the bronchus, especially if it is simply suspended in the bronchoscope. If the lamp with its carrying rod is in a separate compartment, as in Einhorn's and Jackson's instruments, it is much better protected. With this arrangement secretion entering the end of the tube will cover the lamp and the light will either disappear or become dim, and reappear again as the secretion is removed. This happens frequently in the esophagus.

The third essential for extracting foreign bodies by direct inspection is an instrument which can be used through the tube. One form of instrument will not be sufficient for all objects. The most frequently useful will be a forceps with blades of different shapes for seizing. These are made long and narrow and on the general principles of Schrötter's laryngeal forceps. Killian's extracting forceps are made with the blades attached to the tube, through which runs a wire, on the end of which is a broken ring, which closes the blade when it is pushed down upon them. He also has hooks of different shapes for holding objects which are not readily grasped. An instrument designed especially for the removal of a collar stud was made by Morton in Killian's clinic. It is in the general shape of tube forceps, the tube carrying a right angled roughened hook which is passed under the bottom of the stud, a sharp pointed piece of metal is then pushed down, holding the stud firmly between its point and the hook. A year ago, I had a forceps made in which the handle is attached at right angles to the central shaft carrying the blades, giving a firm hold to the hand. The barrel or tube surrounding the central shaft is pushed down onto and closes the blades by the action of a trigger operated by the forefinger, the rest of the hand maintaining a firm hold on the handle. The operator is thus able to look along the shaft of the instrument without bending it, and to control the farther end under direct inspection. The central shaft is screwed into the handle so that it can be adjusted to open in any direction, and as the blades are closed by pushing the barrel onto them, not by pulling them into the barrel, they do not draw away from the object to be seized at the moment of grasping. A somewhat similar forceps was designed by Stark. For lower bronchoscopy, where the distance is often short. I have found long thin alligator forceps, such as is described by Willis, a very convenient form.

Magnets have been suggested by De Roaldes, Jackson, MacIntire, von Schroetter and many others, and have been used for extraction by Garel, Guisez and Thost. Their use is more limited than at first thought might appear. Not only is a special and more or less elaborate magnet required, but the foreign body must be of iron and free to move, in which case it could often be easily and more accurately extracted with forceps. It would be especially useful if a small iron body had become lodged in a small bronchial tube beyond the range of vision, or if a number of small pieces of iron, such as iron filings, had been inhaled, or if the body were of such a shape that it could not be seized by forceps or hooks.

Secretion may give much trouble by being blown out through the tube or by obstructing the view. Coughing may often be stopped by better local or general anesthesia. If secretion hides the field, it may be sponged with cotton or sucked out with Killian's pump. Great care must be taken that the cotton used in sponging is not left in the bronchus. It should be securely locked on to the carrier. I have made and used a carrier in which the blades which seize the cotton are locked by a collar which screws down upon them.

Upper bronchoscopy is, of course, the ideal method of extraction of foreign bodies. The passage of the bronchoscope involves little danger, no after-treatment, no scar. Nevertheless, lower bronchoscopy is an operation of greatest value, and one which should be widely published and generally understood. The upper route is theoretically more liable to lead to infection of the lower air passages than tracheotomy, because the tubes must necessarily come in contact with the mouth and pharynx. Experience, however, does not seem to prove this danger. There is danger in infants that the trauma to the larynx may cause serious edema; such cases have been reported by Nehrkorn and von Schroetter, but in adults this danger is slight. As a general rule in cases of emergency, tracheotomy should be done. If the object is free in the trachea it will often be expelled through a tracheotomy wound, whereas delay might allow it to become impacted in the larynx or lost in a bronchus. Tracheotomy would probably be indicated also if there were dyspnea or collapse, or if the patient's strength were limited and for any reason the search were likely to be prolonged or difficult. It seems to me that the resulting scar after a tracheotomy is to be considered to a certain extent, and that it would be justifiable to persist in the attempt through the natural passages before opening the trachea longer in the case of a young woman or girl than in a man or boy. In a certain number of cases the object cannot be reached through the natural passages, or the attempt would involve more danger than the added danger of tracheotomy. And also for some time to come, the treatment of inspired foreign bodies must often be undertaken without an equipment of elaborate instruments, and by men who have had no experience in the matter.

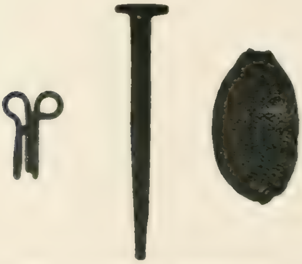
While it must for some time be only the man especially equipped who will be able to remove a foreign body from a bronchus through the natural passages, a little knowledge will enable many provided only with a short hollow tube, a long pair of forceps and a head mirror to save the lives of their patients, with no more danger than is involved in the tracheotomy. The one important fact upon which the operation is based, and which should be demonstrated to every surgeon, is that after a tracheotomy a straight tube may easily be passed through the wound, turned at right angles and pushed down the lower section of the trachea. If necessary, by using a perforated tube, it may be continued for some distance down either bronchus. Through the tube the foreign body can generally be seen and seized. In reading reports of foreign body extraction published before this most simple method was suggested, we find the operator fishing in the bronchi with forceps and hooks and even cork screws, often unsuccessfully, whereas in many of the cases the object would have been easily found and removed by direct inspection.

In my experience, cases of foreign body in the air passages are not very frequent, but foreign bodies in the esophagus are more so, and in many respects involve the same problems and are reached by the same instruments, as in upper bronchoscopy. I have already reported before this association five cases in which I have removed foreign bodies from the bronchi. I should like now to report three more which illustrate certain points.

T. L., a boy aged 8 years, was referred to me by Dr. Leland, April 1, 1905. Eight days previously he had inhaled a prune stone, followed by cyanosis and struggling, lasting many minutes. He has since had similar but less violent attacks. He had periodically considerable pain in the chest, at first on the right side, later over the whole front. When seen, he had periodic, severe attacks of coughing, a little purulnt expectoration, occasionally with blood, diminished breathing on the right side and coarse rales on both sides; temperature, 100 to 103. The X-ray showed nothing. Killian's tube was passed to the bifurcation, through the upper passages, under ether, but the amount of secretion prevented a satisfactory view. Two days later, the conditions being the same, I did tracheotomy below the isthmus of the thyroid, and a short tube was passed into the right bronchus. After sponging much mucopurulent material, the stone was seen with the edge presenting, impacted low in the right primary bronchus. I seized it with my forceps, but it was so firmly held in place by the swollen mucous membrane that it was a considerable time, using all the force that I dared, before I could dislodge it. The patient's temperature after the operation at once fell to normal, and he made an uninterrupted recovery. This case is interesting as showing that a foreign body may become so firmly held by its own swelling and that of the mucous membrane as to cause a serious obstacle to removal. It also shows, as has been often noted before, that even considerable infection in the lung, accompanied by a certain amount of trauma, will often disappear immediately as soon as the offending object is removed.

The second case may be considered as typical of the value of upper bronchoscopy.

J. D., a boy aged 9 years, entered the hospital Oct. 2, 1905. Three days before, while playing, he had inhaled a shingle nail. There was severe coughing and choking at the time, which has continued periodically since, with a feeling of discomfort in the sternal region. There has been no blood nor dyspnea. The X-ray showed the nail apparently in the left bronchus, just below the bifurcation. The next day the child was etherized, after subcutaneous injection of atropin, placed on a table with the head over the end, the larynx cocainized through the autoscope and Killian's tube passed through the glottis and down to the bifurcation. The illumination was by the small lamp at the distal end, after Einhorn's model. The nail was seen in the left bronchus point up and removed at the first attempt with Killian's forceps. The patient had no further symptoms. In a case of this kind the value of upper bronchoscopy is manifest. The necessity for a general anesthetic might be questioned. This as well as the question of the upper or lower method must be left to the operator, and must depend upon the patient and the probable difficulty to be encountered in reaching and removing the foreign body.



Foreign bodies removed.

The third case was a girl aged 2 years 3 months, seen May 30, 1906. Four days previously she had inhaled a hook, such as is attached to an eye on clothing. At the time there was violent respiratory spasm, and a little dyspnea. There has been paroxysmal cough since. The X-ray showed the foreign body just below the fifth rib a little to the right of the vertebral column. Under ether, a Killian tube of small diameter lighted with the small distal lamp, was passed into the larynx. There was a slight subglottic swelling, especially on one side, and the glottis appeared to be just too small to admit the tube easily. Fearing subsequent laryngeal swelling if I persisted, I abandoned the upper route, did tracheotomy and through a short tube immediately saw and removed the foreign body from the right bronchus. There was a little mucopurulent secretion surrounding the hook at the time of its removal, but not enough to cause any trouble. The child is now, two weeks later, doing well.

In this case I think I could have removed the foreign body by upper bronchoscopy, but recalling the experience of Nehrkorn and Schroetter in cases of infants, referred to above, it seemed to me safer to take the lower route.

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LII.

A STUDY OF THE ANATOMY OF THE ACCESSORY CAVITIES OF THE NOSE BY TOPOGRAPHIC PROJECTIONS.*

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An accurate comparison of the nasal accessory sinuses of man with one another, and with those of other human heads, has not been possible with the methods in vogue up to the present time. A large degree of error is to be expected in view of the great variety in numbers, form, size and relations, and the difficulty of establishing a definite standpoint for comparison. It is for the purpose of approaching the solution of this problem that this study has been undertaken.

Our knowledge of the morphology of the accessory sinuses has come to us from investigations made for many years, in many ways. One of the earliest methods was that of disarticulated bones, which naturally could give only an indefinite idea of the relations and but meager information of the size and shape.

Examination of the articulated skull possessed the advantage of retaining the sinuses in proper relation, even if they could not all be seen. An important step forward was the use of the articulated skull with portions cut away, so as to show the sinuses as they lie. A moderate understanding of the maxillary, frontal and the sphenoid sinuses may be obtained in this way, and, in specially prepared specimens, the ethmoid labyrinth may be fairly well observed.

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A much better plan is to treat the head, with the soft parts attached, in this way. Before the method of decalcification was used, it was necessary to remove the bone with saws, chisels, etc., but with decalcification, an ordinary knife may be employed.

Corrosion preparations, when well made, show the volume and interrelations of the sinuses, supplanting the hollow form by a solid cast. But, of necessity, the specimen from which the preparation was made is destroyed and, hence, the exact relation of the adjacent parts cannot be fixed.

Radiography is of considerable service in demonstrating the outlines of the sinuses, under favorable circumstances.

Serial sections made in sagittal, coronal and horizontal ways show fairly well the relation, size and form of the sinuses, whether they be frozen and sawed, or decalcified and cut with a knife. The chief difficulty, as to comparisons, lies in the fact that it is impossible to secure sections of uniform thickness and of identical positions in a series of heads. As a consequence, the pictures at the level of the sections differ accordingly.

To overcome these difficulties, a plan is here proposed which follows logically the reconstructions as made by numerous biologists, and the work of Jackson* in the study of the relations of the body structures with serial sections, and that of Potter†, by means of which the internal organs of man are accurately reconstructed so as to show their topographic relations. Potter projected the organs in the anterior portions of the chest and abdomen on the anterior surface; those in the posterior portion, on the posterior surface; those on the right side to the right, and those on the left to the left.

Manifestly, while it is desirable to secure an accurate picture of the greatest diameter of the sinuses shown on the corresponding sides, laterally, anteriorly and superiorly, for the purposes of comparison, it is necessary to reconstruct both sets of sinuses on the one side, using the same projection plane; otherwise the comparisons would be full of errors and therefore valueless. On this account it became necessary to modify Potter's method in some particulars.

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*C. M. Jackson. "A Method of Teaching Rational Anatomy." Jour. A. M. A., September 21, 1901.

†Potter. "Topography of the Thorax and Abdomen." 1905.

Potter's method consists in projecting the organs on the surface of the body, as it were, by establishing a base line from which measurements are made on the surface of the section; in each section the extreme distances, centrally and peripherally, of the organ to be reconstructed, are taken from a line connecting the intersecting points of the base line on the surface of the sections, and these are properly designated on millimeter paper, upon which the outline of the body has already been accurately made and the base line accurately indicated. When this is done for the successive sections, the points designate where the upper portions of the section pass through the organs at the greatest and least distance from the base line, taken as zero. The course of the organ in the sections is shown on the millimeter paper after determining it by careful study, measurement and comparison.

PREPARATION OF THE SECTIONS.

The head used for the projections was that of a full grown man weighing about 150 pounds, about 5 feet 7 inches in height. It was first injected with a 50 per cent formalin solution, after the method of Jackson, and then immersed in a 3 per cent solution of hydrochloric acid for three months, by which time the bones were entirely decalcified. It was then moderately frozen and sectioned.*

The sections were made as uniform as possible in thickness, both as to different sections and the two sides of the sections.

It was found, that when an attempt was made to cut sections of a decalcified head, moderately frozen, there would be considerable sagging, due to the weight of the head upon the softened framework. Great care was necessary to obtain sections of uniform thickness, which is most essential.

For the purpose of reconstruction and projection, it is not material in what directions the sections are made—horizontal, sagittal or coronal—although the horizontal has been found the most satisfactory and convenient form.

Before the sections are made, the head is photographed, for the purpose of securing as accurately as possible right and left profiles, and an anterior view. By the use of a rule, placed in the same focus as the head, it was possible to enlarge the photograph so as to secure a natural size picture. The markings which show on the photograph are important in designating the exact position of the sections.

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*It is not necessary to freeze the head before making the sections, though this somewhat facilitates the process.

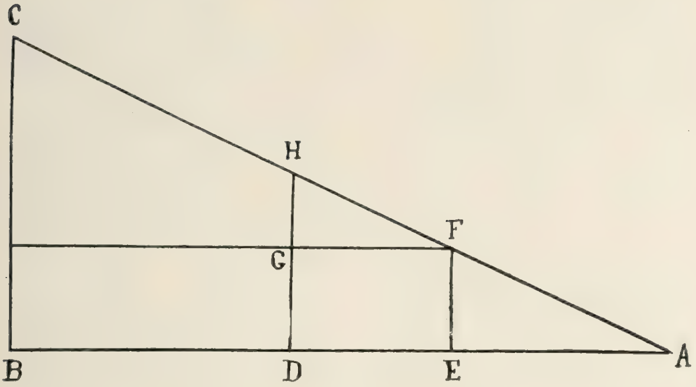
A drawing of the top of each section is now made with India ink on an oblong piece of glass in a frame, care being taken to make the drawing lines directly parallel to the lines of the sections. From the glass it is redrawn on tracing paper. (See Pl. I to VI.)

While the projection can be made without these drawings, they are of great assistance in verification, by furnishing a control for each measurement made on the sections.

There is practically no displacement of the sinuses such as there is from the contracting effects of formalin on soft organs, as these are all encased in bony walls, which, although decalcified, still have a fairly firm framework.

Establishment of the Base Line.

The accurate projection naturally depends upon the correct establishment of the base line, from which the sinuses are to be measured. It is important where comparisons are to be made, that the base line should be more or less uniform for a series of heads, though this is not absolutely necessary. It goes without saying that the line on the sections and that on the projection must occupy the same relative position, otherwise the errors will be innumerable. The lines on the two sides of the head should be in the same plane, perpendicular to the horizontal basal plane of the head. When the sinuses are to be projected to the respective sides of the head, minor or even considerable deviations of the lines on the two sides of the head are of no significance, but where comparisons are to be made between the two sides from projections made on the two sides, the errors become at once manifest. To overcome this, it was found expedient to project first the left sinuses to the left side and the right upon the inverted left outline. The latter gives the proper picture for the projection of the right sinuses on the right side. The possibility of error can be easily calculated.



In the figure here shown, *ab* represents the line connecting the two correct base line points, and *c* the intersection of the incorrect base line with the section. *d* and *c* are corresponding points on the two sinuses to be compared on the two sides of the head. The extreme error would therefore be *gh*, and the lesser errors would be represented by lines parallel to *gh* lying between *g* and *f*, depending on the part of the two sinuses subjected to comparison. The following formula would therefore represent the error, $gh : cb = cd : ab$; wherefore,

$$gh = \frac{cb \times ed}{ab}$$

Given *cb*, or the distance between the true and the false base line as 1 cm. (far more than likely), the error in comparing the sinuses in the lateral projections is shown in millimeters in the following table, taking in each instance the section showing the greatest possibilities in this direction:

Sinus.	Section.	Greatest Error.	Least.	Average.
Maxillary.	5	5.3	2.0	3.65
Sphenoid.	4	2.1	−0.3	0.90
Frontal.	1	2.5	0.	1.25
Anterior Ethmoid. . . .	3	1.7	0.6	1.15
Posterior Ethmoid. . . .	3	1.9	0.4	1.15

It is thus seen that, with the exception of the maxillary sinus, the error is insignificant, and whatever error there is in comparing the maxillary sinuses readily rights itself by the checks which adjacent structures force upon the projector.

In the anterior projection, the error would be much less, the maximum (the sphenoid) being only .04 mm.; in the superior projection, since the measurements are made with reference to both base lines, the error will be equal to that of the lateral or the anterior projection, depending on whether the lateral or the antero-posterior diameter be considered.

The lateral base lines have been drawn through a crease just anterior to the tragus of the ear, and the anterior through the middle line of the nose and occiput, measuring from the two tragi. The superior surfaces of the section were nicked with a knife just where the base lines intersected them, leaving marks so clear that notwithstanding the repeated handling of the sections they still persist. Marks made by ink or pencil did not survive long.

MEASUREMENTS.

The sinuses are measured with respect to their greatest and shortest distances from a straight line connecting the points of intersection of the two base lines with the superior surface of the section, taken as zero. To facilitate this, a frame has been constructed holding an oblong glass which is ruled with lines 1 cm. apart. One of the lines is placed so as to cover the two intersecting base line points, and the readings are taken posterior and anterior to the measuring line for the lateral reconstruction, and to the right and left for anterior reconstruction. The following are the figures obtained in millimeters:

ANTERIOR RECONSTRUCTIONS.*

LEFT.

Sections.	—One—		—Two—		—Three—		—Four—		—Five—		—Six—	
Profile.	84	..	79	..	78	..	74	..	74	..	71	..
Cranial Cavity.	70	0	71	0	70	0	65	0	5	03R	50	04R
Frontal.	01	18	01R	12	..	..	..	..	..	..	..	..
First Ethmoid	..	..	03	12	05	12	..	..	..	..	..	..
Second Ethmoid	..	..	..	..	04	13	..	..	..	..	..	..
Third Ethmoid	..	..	..	..	03	14	..	..	..	..	..	..
Fourth Ethmoid	..	..	..	..	03	08	..	..	..	..	..	..
Fifth Ethmoid	..	..	..	..	03	14	..	..	..	..	..	..
Sphenoid.	..	..	..	..	08R	13	02	17	..	..	..	..
Maxillary.	..	..	..	..	..	..	11	27	15	39	17	27
Ear.	..	..	..	..	88	..	..	..	..	..	..	..
Septum.	..	..	..	..	0	..	03	..	01R	..	..	..
Hiatus-Infundibulum.	..	..	..	..	02	05	..	..	..	..	..	..
Inferior Turbinate.	..	..	..	..	..	..	..	..	05	15	..	..
First Ethmoid Turbinate.	..	..	..	..	02	..	06	13	..	..	..	..
Second Ethmoid Turbinate.	..	..	..	..	02	..	10	..	..	..	..	..
Naso-Lachrymal Canal.	..	..	..	..	10	12	12	13	..	..	..	..

*All measurements are towards the corresponding side of the base line. Where there is any difference, this is indicated by R (right) and L (left).

RIGHT.

Sections.	—One—		—Two—		—Three—		—Four—		—Five—		—Six—	
Profile	77	..	78	..	77	..	75	..	70	..	68	..
Cranial Cavity	68	0	70	0	68	0	64	0	56	03	48	04
Frontal	22	0	13	01L.	..	..	..	..	..	..	..	..
First Ethmoid	..	..	..	..	10	06	..	..	..	..	..	..
Second Ethmoid	..	..	..	..	08	12	..	..	..	..	..	..
Third Ethmoid	..	..	11	09	..	..	..	..	..	..	..	..
Fourth Ethmoid	..	..	..	..	05	14	..	..	..	..	..	..
Fifth Ethmoid	..	..	..	..	03	08	..	..	..	..	..	..
Sixth Ethmoid	..	..	..	..	03	07	..	..	..	..	..	..
Seventh Ethmoid	..	..	..	..	05	10	..	..	..	..	..	..
Eighth Ethmoid	..	..	..	..	03	14	..	..	..	..	..	..
Ninth Ethmoid*	..	..	..	..	03	15	..	..	..	..	..	..
Sphenoid	..	..	..	..	..	..	14	07L	..	..	..	..
Maxillary	..	..	..	..	..	..	25	12	38	14	30	18
Septum	..	..	..	..	02	..	05	14	..	..	..	..
Ear	..	..	..	..	86	..	..	..	..	..	..	..
Hiatus-Infundibulum	..	..	..	..	03	10	..	..	..	..	..	..
Inferior Turbinate	..	..	..	..	05	13	..	..	..	..	..	..
First Ethmoid Turbinate	..	..	..	..	02	..	05	14	..	..	..	..
Second Ethmoid Turbinate	..	..	..	..	02	..	08	..	..	..	..	..
Naso-Lachrymal Canal	..	..	..	..	09	11	12	14	..	..	..	..

*One ethmoid was not cut by the section.

LATERAL RECONSTRUCTIONS.*

LEFT.

Sections.	—One—		—Two—		—Three—		—Four—		—Five—		—Six—	
Profile.	71	104P	75	105P	85	103P	95	102P	100	99P	84	89P
Cranial Cavity.	54	93P	47	95P	28	93P	2	88P	12	80P	13	68P
Frontal.	56	64	43	58	..	..	..	..	..	..	..	..
First Ethmoid	..	..	51	61	47	56	..	..	..	..	..	..
Second Ethmoid	..	..	..	..	37	50	..	..	..	..	..	..
Third Ethmoid	..	..	..	..	33	42	..	..	..	..	..	..
Fourth Ethmoid	..	..	..	..	33	37	..	..	..	..	..	..
Fifth Ethmoid	..	..	..	..	19	33	..	..	..	..	..	..
Sphenoid.	..	..	..	..	8	26	2	23	..	..	..	..
Maxillary.	..	..	..	..	..	..	27	63	28	61	33	53
Ear.	..	..	..	..	12P	38P	..	..	..	..	..	..
Hiatus-Infunibulum.	..	..	..	..	42	52	..	..	..	..	..	..
Inferior Turbinate.	..	..	..	..	..	..	..	..	31	63	..	..
First Ethmoid Turbinate.	..	..	..	..	43	54	32	52	..	..	..	..
Second Ethmoid Turbinate.	..	..	..	..	26	42	25	..	..	..	..	..
Naso-Lachrymal Canal.	..	..	..	..	57	61	56	58	..	..	..	..

*All measurements except those marked P (posterior) are anterior to the base line.

RIGHT.

Sections.	—One—		—Two—		—Three—		—Four—		—Five—		—Six—	
Cranial Cavity	56	94P	47	95P	23	92P	21	87P	12	80P	13	67P
Frontal	56	66	45	62	..	..	..	..	..	..	..	..
First Ethmoid	..	..	..	..	51	57	..	..	..	..	..	..
Second Ethmoid	..	..	..	..	45	49	..	..	..	..	..	..
Third Ethmoid	..	..	..	..	..	..	42	44	..	..	..	..
Fourth Ethmoid	..	..	..	..	33	43	..	..	..	..	..	..
Fifth Ethmoid	..	..	..	..	36	41	..	..	..	..	..	..
Sixth Ethmoid	..	..	..	..	31	36	..	..	..	..	..	..
Seventh Ethmoid	..	..	..	..	33	36	..	..	..	..	..	..
Eighth Ethmoid	..	..	..	..	28	32	..	..	..	..	..	..
Ninth Ethmoid	..	..	..	..	14	29	..	..	..	..	..	..
Sphenoid	..	..	..	..	..	..	29	6P	..	..	..	..
Maxillary	..	..	..	..	..	..	26	63	26	60	37	55
Ear	..	..	..	..	25	33	..	..	..	..	..	..
Hiatus-Infundibulum	..	..	..	..	43	54	..	..	..	..	..	..
Inferior Turbinate	..	..	..	..	..	..	..	..	35	62	..	..
First Ethmoid Turbinate	..	..	..	..	43	55	31	53	..	..	..	..
Second Ethmoid Turbinate	..	..	..	..	27	42	25	..	..	..	..	..
Naso-Lachrymal Canal	..	..	..	..	56	62	55	58	..	..	..	..

Reconstruction on Millimeter Paper.

A prominent line on the millimeter paper is taken as the base line and each section is indicated by measuring its thickness at the base line and at other points more or less fixed, and by measuring distances from spots shown on photographs of the head. A little practice makes this an easy matter. At the extreme ends, the lines indicating the section levels will curve on account of the perspective; however, ordinary care only is necessary, as the sinuses being centrally placed do not come into relation with the extreme anterior, posterior, right and left portions of the projection. Having projected the lines of the sections on the millimeter paper, they are delimited and the contour established by lines drawn through points on the millimeter paper, in accordance with the measurements of the outline; the particular form of the line connecting the points will depend on the boundaries of the section. This gives an outline of the projected surface with the sections indicated by lines and the base line properly projected.

In accordance with the measurements, points representing the proximal and distal points of each sinus are indicated on the line representing the superior surface of each section in which it appears.

With these points and adjacent structures and reconstructions as guides, the course of the sinuses through the sections is carefully noted and traced on the millimeter paper. (Pl. VII.) A little practice makes it possible to do this speedily and accurately, although it is confusing at first. It must be remembered, that it is possible to represent on the lateral projection only the antero-posterior and supero-inferior diameters, on the anterior projection, the lateral and supero-inferior diameters, and on the superior projection, the lateral and the antero-posterior diameters. In this way each diameter is duplicated in the projections, and is thereby controlled.

It is remarkable how speedily an error is discovered, for there is such an interdependence of the different lines upon one another that the slightest variation from the correct picture manifests itself with no uncertain demonstration. Of course, every part of the work is controlled by repeated verifications.

In making the superior reconstruction, the measurements made for both the lateral and the anterior reconstructions are used and the points and lines are fixed by using the measured distances of these projections as co-ordinates. This is somewhat difficult and puzzling at first, but the work soon becomes simple, especially if the lateral and anterior projections are kept constantly at hand for comparison.

The plan used for the superior projection, which differs materially from that of the other projections, is always to be followed when making a projection parallel to the sections.

We have, now, accurate lateral, anterior and superior projections of the various sinuses in their greatest diameters, in proper relation to one another and to various other important structures.

THE COMPLETED RECONSTRUCTIONS.

Having a correct picture on the millimeter paper, it is an easy matter to transfer it to the tracing paper*, from which it may be retransferred in whole or in part to other drawing papers.

Through the medium of tracing paper, the sinuses with the turbinates and other structures are drawn on white drawing paper, the frontal sinuses being colored yellow, the sphenoid green, the maxillary purple, and the ethmoids red, the anterior group being lined horizontally and the posterior perpendicularly. The turbinates, cranial fossae, naso-lachrymal canals and the floor of the nose are represented by spaced black lines and the contour of the head and the infundibulum, with the hiatus semilunaris, in solid black lines. This makes it possible for the eye to follow the outline of the sinuses and other structures without confusion.

The lateral reconstructions show the sinuses with all their divisions, the turbinates, the floor of the nose, the anterior cranial fossa, the naso-lachrymal canal, and the infundibulum with the hiatus semilunaris. The location of the bulla ethmoidalis is noted as the posterior boundary of the hiatus semilunaris. (Pl. VIII and X.)

The anterior reconstruction shows the sinuses, the ethmoid being differentiated into the consolidated anterior group and the consolidated posterior group, as the overlapping would be confusing. The floor of the nose, the bony nasal septum, the turbinates and the naso-lachrymal canal are also shown. (Pl. IX.)

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*I am now discarding the drawing on millimeter paper, as it is far simpler and less time-consuming to make the drawing directly on the tracing paper spread over the millimeter paper as a guide.

In the superior reconstruction, the sinuses are shown complete, the ethmoid being represented in all its divisions. The infundibulum, the naso-lachrymal canal and the attachment surface of the nasal septum to the nasal roof are also designated. (Pl. XI.)

Reconstructions for Comparisons.

In addition to these, reconstructions are made for the purpose of comparing the sinuses of one side, taken together, with those of the other side. This is done by projecting the sinuses of the right side, colored green, over those of the left side colored yellow. As all projections are thus treated, comparisons are possible between the group of sinuses in all diameters, properly controlled by the duplication in the different projections. In addition to this, each sinus is projected over its fellow, each ethmoid group being considered as one, so that it is possible to compare the contour of each sinus with its fellow in three different projections, comprising a duplication of each of the three diameters.

When these drawings are examined, the resemblance of the figures representing the two sides is so great that it is most striking, especially when the variation in the shape of the individual sinuses themselves is considered. For instance, in the lateral projection it is seen that the diameters of the combined sinuses follow one another with remarkable regularity, and when there is any considerable difference there is, as it were, a compensation in another direction. Thus the sphenoid portion of the right side is seen to extend back of the left side but a trifle more than the left extends above the right. The lower borders of the two groups correspond very closely to each other. (Pl. XII.)

A very similar condition of things is to be observed in the anterior projection. There is very little difference in the figures of the two sides except in the sphenoid region, and there the essential difference is in the position of the internal wall of the sphenoid. (Pl. XIII.)

The same thing may be noted in the superior projection, although here the left ethmoid region is somewhat more peripherally placed than the right, the left sphenoid portion is broader and the right sphenoid portion longer, the total amount of the overlapping being about the same. (Pl. XIV.)

Description of the Sinuses.

In the description which follows, no attempt is made to compare what is found in the projected head with that found in any other head or established by any other form of morphologic study. It is intended only to give an accurate description of what is determined in this head by the projection made after the manner stated.

In the main, the measurements given are those between parallel planes, both because the method of projection fixes the distances in this way, and because where there is any inclination in one direction or another, the difference is insignificant or may be readily computed. For instance, if the distance from plane to plane is 40 mm., and the distance in the other direction is 10 mm., the exact distance according to the well-known formula, the square of the base plus the square of the altitude is equal to the square of the hypothenuse, would be

$$\sqrt{1600+100} \text{ or } 41.6 \text{ mm.}$$

If there be a further distance in another direction, the increase will be corresponding. However, points have been selected where these differences are at a minimum.

Maxillary Sinus.

Left Maxillary. In describing this sinus, no account is taken of the small canal 6 mm. long and 5 mm. in diameter, connecting the sinus with the first anterior ethmoid cavity on the left side. It appears to be an accidental communication close to the opening of the maxillary sinus into the hiatus. (Pl. VIII.)

The left maxillary sinus extends 33 mm. in a vertical direction, 27 mm. laterally, 36 mm. antero-posteriorly, and 5 mm. below the floor of the nose.

The inferior turbinate runs along its inner wall, extending 7 mm. anterior and 10 mm. posterior to the sinus. The turbinate covers the inner wall for a distance of 34 mm. antero-posteriorly, occupying 13 mm. vertically at its widest portion

(5 mm. behind the orifice of the naso-lachrymal canal), and 7 mm. in its narrowest portion, at its posterior extremity.

The first ethmoid turbinate passes downward and backward over the inner wall of the sinus, the anterior border crosses it 10 mm., and the posterior border 25 mm. from the anterior extremity of the sinus. It extends 8 mm. posterior to the sinus, and its lower border is 14 mm. above the floor.

The antero-inferior border of the second ethmoid turbinate lies internal to, above and behind the sinus, but descends 7 mm. below the level of the superior wall.

The naso-lachrymal canal which runs along its internal wall for a distance of 11 mm. reaches it 4 mm. behind its anterior wall.

The hiatus semilunaris comes into relation with the maxillary sinus only in the uppermost part of the internal wall, where it passes obliquely downward and backward for 12 mm.; however, on account of the concavity in the superior wall of the sinus, there is no cavity through 4 mm. of this distance.

The upper level of the sinus lies 1 mm. below the lowest level of the anterior ethmoid cells and 4 mm. above that of the posterior. The internal wall of the ethmoid cells is 10 mm. nearer the median line than the anterior wall of the maxillary in its upper portion and 14 mm. in its lower. (Pl. IX.)

It does not come into direct relation with the sphenoid, the anterior wall of which is 4 mm. behind its posterior extremity; however, the anterior projection shows that the infero-external extremity of the sphenoid is 18 mm. below the level of the superior wall of the maxillary sinus.

The lower wall of the frontal is 10 mm. above the upper wall of the maxillary, which is surmounted by a small tongue of the frontal 7 mm. by 6 mm. (Pl. XI.)

RIGHT MAXILLARY. The vertical diameter of the right maxillary is 34 mm., the lateral 27 mm., and the antero-posterior 38 mm. Its floor extends 4 mm. below the floor of the nose. (Pl. X.)

The inferior turbinate, whose antero-inferior extremity extends 2 mm. in front of the anterior wall and from 8 to 13 mm. behind the posterior, covers a space on its internal wall 31 mm. long and 12 mm. wide at its widest portion, and 6 mm. at its narrowest.

The first ethmoid turbinate passes downward and backward over the inner wall, intersecting it 10 mm. and 25 mm. behind its anterior wall, the posterior intersection being 11 mm. in front of its posterior wall. The posterior extremity of the first ethmoid turbinate passes 5 mm. behind the posterior wall of the sinus, whose inferior wall is 16 mm. below the inferior border of the first ethmoid turbinate.

The antero-inferior border of the second ethmoid turbinate just crosses over the postero-superior wall of the sinus, and the posterior border lies above, but almost on a level posterior to the posterior wall of the sinus.

The naso-lachrymal canal reaches the level of the superior wall 4 mm. behind the anterior wall of the sinus, and extends from this place 13 mm. downward.

The hiatus semilunaris extends along the upper wall for a distance of 13 mm., beginning 9 mm. behind its anterior wall and ending 11 mm. in front of its posterior wall.

The anterior ethmoid cells lie above and internal to the maxillary sinus, the posterior likewise, except that posteriorly the internal wall passes internal to their outermost wall to the extent of 1 mm.

This maxillary sinus lies entirely in front of and almost entirely external to the sphenoid, the minimum distance of the planes in the former instance being 2 mm. and the overlapping in the latter being also 2 mm. (Pl. IX.)

The floor of the frontal lies 10 mm. above the roof of the maxillary. The tongue-like projection which overhangs the anterior portion extends laterally 8 mm. and antero-posteriorly 10 mm. (Pl. XI.)

Comparisons. The two maxillary sinuses correspond very closely to each other, the left being slightly greater in a lateral direction, while the right is longer in an antero-posterior and in a vertical direction, except at the level of the canal leading up to the anterior ethmoid. (Pl. XII, XIII and XIV.)

SPHENOID SINUS.

LEFT SPHENOID. The floor of the left sphenoid projects 9 mm. above the highest level of the floor of the nose, though the vertical distance from the posterior part of the floor is 15 mm. The vertical distances of its roof from these points are 36 mm. and 42 mm. respectively, making its vertical diameter 27 mm. (Pl. VIII.) Its greatest lateral diameter is 27 mm.

and its antero-posterior diameter is also 26 mm. In its upper portion, it projects to the right of the median line about 8 mm., extending 6 mm. beyond a slightly convex nasal septum. (Pl. III, 6.) A large portion lies above its fellow and slightly anterior to it. (Pl. IX and XI.)

It does not come into relation with any other sinus except a large posterior ethmoid, which borders it anteriorly and externally. (Pl. III, 5, and XI.) It projects 7 mm. anterior to the posterior border of this cell and 14 mm. external to its internal wall.

Its anterior wall is 26 mm. from the most anterior portion of the bulla ethmoidalis and 30 mm. from the plane of the posterior wall of the naso-lachrymal canal. It is 16 mm. from the posterior wall of the infundibulum. Its anterior wall lies 41 mm. behind the anterior extremity of the inferior turbinate, and its superior wall lies 19 mm. above the highest level of the inferior turbinate. Its floor almost reaches the lowest level of the first ethmoid turbinate and is 10 mm. below the lowermost level of the second ethmoid turbinate.

RIGHT SPHENOID. The floor of the right sphenoid sinus lies 9 mm. above the highest level of the floor of the nose and 14 mm. above the posterior portion of the floor. The vertical distance to the roof of the sphenoid from these points are 28 mm. and 33 mm. respectively, making the vertical diameter 19 mm. (Pl. X.) The lateral diameter is 22 mm. and the antero-posterior is 29 mm. In its lower portion it projects beyond the median line to the extent of about 7 mm., extending 4 mm. beyond the nasal septum, bent convexly to the right. (Pl. IV, 4.) It lies below the left sphenoid sinus for most of its extent. (Pl. IX.)

The most posterior of the ethmoid cells surmounts it for an antero-posterior extent of 10 mm. and laterally 11 mm. A second posterior ethmoid cell almost reaches it at its anterior external wall. Its anterior wall is 25 mm. posterior to the most anterior point of the bulla ethmoidalis and 32 mm. from the posterior wall of the naso-lachrymal canal. It is 16 mm. from the posterior wall of the infundibulum. Its anterior wall lies 39 mm. behind the anterior extremity of the inferior turbinate and its superior wall lies 12 mm. above the highest level of this turbinate. Its floor is a shade lower than the lower border of the first ethmoid turbinate and 10 mm. below the lowest level of the second ethmoid turbinate, and its anterior wall is 2 mm. behind the posterior border of the second ethmoid turbinate.

Comparisons. The two sphenoids show a marked difference from each other, the left extending 9 mm. above, 2 mm. below, and 4 mm. to the side of the right sphenoid, while the right extends 8 mm. behind the left. (Pl. XII, XIII and XIV.)

FRONTAL SINUS.

The frontal reaches the highest level of any of the sinuses. The projections show the possibility of the correctness of the view that the frontal sinuses are simply diverticula of the ethmoid which have been interposed upward between the laminae of the frontal bone.

LEFT FRONTAL. The frontal is the most anterior of all the cells on the left side, although the maxillary reaches almost the same plane. Its greatest dimensions are, vertically 30 mm., laterally 20 mm. and antero-posteriorly 21 mm.; 9 mm. from its roof, its anterior wall is at the maximum distance from its extreme posterior wall. At 13 mm. this is reduced to 14 mm.; at 17 mm. it is increased to 15 mm., and at 25 mm. it is only 6 mm. This is due to the recession of the anterior wall which is replaced by an ethmoid cell projected upward to within 11 mm. of the roof of the frontal. (Pl. II, 4 and Pl. VIII.)

The highest point of its roof is 67 mm. above the anterior part of the floor of the nose, 55 mm. above the anterior extremity of the inferior turbinate, 50 mm. above its highest level, 46 mm. above the lowest level of the anterior border of the first ethmoid turbinate, 40 mm. above the junction point of the first ethmoid turbinate with the maxillary sinus anteriorly, 33 mm. above the upper surface of the bulla ethmoidalis. The floor of the cavity is 30 mm. nearer these points.

It descends to 1 mm. above the plane of the roof of the sphenoid sinus, and its most posterior point is 16 mm. in front of the anterior wall of the sphenoid.

Its outer wall lies directly above the supero-internal angle of the maxillary which lies 10 mm. below its inferior wall. (Pl. IX.)

Its relation to the ethmoid cells is well shown. Its upper portion lies above the most anterior ethmoid cell, while its posterior portion, which is vertical, lies between this and the large ethmoid cell immediately behind it. It reaches the infundibulum in this space. It thus has the appearance of an ethmoid cell lying between the two others, but reaching a point 11 mm. higher than the one and 21 mm. higher than the other, and extending laterally almost twice and antero-posteriorly one and one-half times as far as either of these cells. The anterior wall of the first posterior ethmoid cell lies 1 mm. behind its posterior extremity, and that of the most posterior ethmoid cell, 11 mm. (Pl. VIII.)

RIGHT FRONTAL. The frontal is the most anterior of all the sinuses on the right side, being 5 mm. anterior to the ethmoid and 2 mm. to the maxillary. Its greatest diameters are vertically 30 mm., laterally 24 mm., and antero-posteriorly 22 mm. Its anterior wall passes quite uniformly downwards and backwards, while the posterior wall, after passing almost parallel to this for three-fourths of its distance, turns sharply backwards. As a consequence, the maximal antero-posterior diameter is at the lower part of the sinus, while the minimal is at the roof. (Pl. X.)

The roof is 68 mm. from the anterior part of the floor of the nose, 59 mm. from the anterior extremity of the inferior turbinate, 52 mm. from its highest level, 47 mm. above the inferior level of the anterior end of the first ethmoid turbinate, 42 mm. from the intersection of the first ethmoid turbinate with the maxillary, 34 mm. from the highest level of the bulla ethmoidalis. The floor is 30 mm. nearer these points.

It is 10 mm. above the roof of the sphenoid, the anterior wall of which is located 21 mm. behind its posterior wall. Its outer wall lies directly above a small portion of the maxillary sinus to the extent of 10 mm. laterally.

It is superimposed immediately above the anterior ethmoid group of cells and is in contact with the two upper cells of this group. One of these cells extends 2 mm. behind the posterior wall, and while the other extends anterior to the lower portion of the anterior wall, it is overhung by the upper portion.

The most posterior of the ethmoid cells lies 2 mm. behind its posterior wall.

Comparisons. The right frontal is much larger than the left frontal, the anterior wall of the latter being replaced by the ascending anterior ethmoidal cell. These two taken together about equal the right frontal in size and shape. There is very little difference in the vertical diameter of the two sinuses, but the right extends a considerable distance more externally and a small distance more anteriorly. (Pl. XII, XIII and XIV.)

ETHMOID CELLS

LEFT ETHMOID. The left ethmoid labyrinth lies below the frontal, above and internal to the maxillary, and in front of the sphenoid. On the left side, the greatest vertical diameter is 34 mm., the antero-posterior 42 mm., and the lateral 12 mm.

The anterior group is composed of two large cells, the first running downwards and backwards, the other downwards and forwards. The infundibulum lies inward between these, although the inner wall of the first ethmoid is on the same level internally. The bulla ethmoidalis is constituted by the inner and the infero-anterior wall of the second cell. The first cell extends 11 mm. higher than the second, and the latter 5 mm. lower than the former.

The following show the distances from the highest levels of the two cells taken together: Floor of the nose, anterior level, 56 mm., anterior end of the inferior turbinate 44 mm., highest level of inferior turbinate 39 mm., lowest level of the anterior border of the first ethmoid turbinate 35 mm., intersection of the first ethmoid turbinate with the wall of the maxillary sinus 27 mm., upper border of the bulla ethmoidalis 22 mm. At the level of the upper border of the bulla ethmoidalis, which lies at the posterior wall of the first cell, the first cell extends 8 mm. anterior and the second 12 mm. posterior. The second cell overlaps the first posterior ethmoid cell antero-posteriorly almost the entire distance. The posterior wall of this cell lies 8 mm. anterior to the anterior wall of the sphenoid sinus. (Pl. VIII.)

The posterior group of cells consist of three cells, two of which are large, constituting the superior, posterior, and anterior, and a much smaller one lying inferiorly. They encroach 7 mm. upon the sphenoid and 7 mm. upon anterior ethmoid, antero-posteriorly.

RIGHT ETHMOID. The right ethmoid labyrinth comprises ten distinct cells, of which four belong to the anterior group and six to the posterior. The greatest vertical diameter is 28 mm., its lateral 12 mm., its antero-posterior 47 mm. The dimensions of the anterior group, considered from the standpoint of the greatest diameters, are vertically 20 mm., laterally 7 mm., and antero-posteriorly 29 mm. The corresponding dimensions of the posterior group are 25 mm., 12 mm., and 29 mm.

The infundibulum lies internal to the anterior group of cells and anterior to the posterior group. The bulla ethmoidalis is formed by the anterior wall of the two lower anterior ethmoid cells. The most anterior ethmoid cells lies just below the frontal and internal to the naso-lachrymal duct, above the level of which most of it is situated. The second cell, which is behind the first cell, lies below the frontal and extends somewhat posterior to it. Below this cell are to be found the two cells whose anterior walls constitute the bulla ethmoidalis. The first of these is only half the length, antero-posteriorly, of the second cell, placed immediately below. The last cell is the only one of the anterior ethmoid cells which projects into the region of the posterior ethmoid, the overlapping antero-posteriorly being 10 mm. and vertically 9 mm. The following show the distances from the highest level of the cells of the anterior group: Floor of the nose, anterior level, 48 mm., anterior end of the inferior turbinate 39 mm., upper level of the inferior turbinate 32 mm., lowest level of the anterior border of the first ethmoid turbinate 26 mm., intersection of the first ethmoid turbinate with the wall of the maxillary sinus 22 mm., upper border of the bulla ethmoidalis 14 mm. The first cell extends 12 mm. anterior and 2 mm. posterior to the antero-superior border of the bulla ethmoidalis. The floor of the second cell is 5 mm. above it, and extends 7 mm. behind it. As already stated, the wall of the bulla is a portion of the anterior wall of the two other anterior ethmoid cells. As the upper part of the bulla is 8 mm. above the intersection of the first ethmoid turbinate and the maxillary sinus, 25 mm. above the anterior end of the inferior turbinate, and 34 mm. above the floor of the nose, the distances of these structures from the floor of the four cells can be readily ascertained. The bulla is 13 mm. behind the anterior end of the inferior turbinate. (Pl. X.)

The posterior group of cells may be considered as a cavity with numerous septa dividing it into smaller cells, occupying the lateral mass of the ethmoid bone behind the anterior ethmoid cells. They lie above and in front of the sphenoid and above, behind and to the inner side of the maxillary. The most posterior cell overlaps the sphenoid to the extent of 10 mm., being directly in relation laterally and posteriorly with the sphenoid on the other side. Below this is a narrow cell which approaches the maxillary and follows it for a distance of 15 mm.

Comparisons. The left anterior ethmoid cells appear to be very much more extensive than the right, by reason of the very large ascending anterior ethmoid cell. It is by reason of this that the left anterior ethmoid group of cells reaches a level 6 mm. above that of the right, and extends 4 mm. in front.

The right posterior ethmoid cells are manifestly much larger than the left and appear so in every diameter except the vertical. They lie 3 mm. more internal than those of the left side. (Pl. XII, XIII and XIV.)

Orifices of the Sinus.

In addition to the reconstructions already described, two others have been made, showing the different orifices in their relation to the turbinates, naso-lachrymal canal and other structures. (Pl. XV and XVI.)

The most conspicuous figures in these drawings are those of the infundibulum, hiatus semilunaris and the fossa behind the bulla. The bulla projects, as it were, between the infundibulum above, the infundibulum and hiatus in front, and this fossa behind.

The left infundibulum is 10 mm. in an antero-posterior direction and 5 mm. in a lateral direction. Its anterior half is continued downwards and backwards, by a cleft between the uncinate process and bulla, for a distance of 14 mm. Its posterior half opens into a fossa 6 mm. deep, which passes almost directly downwards.

The right infundibulum is 12 mm. antero-posteriorly and 6 mm. laterally; its anterior half is continued downward, and then backwards, more horizontally than on the other side, for a distance of 20 mm. Its posterior half opens into a fossa corresponding to that on the opposite side, running almost directly downwards for 6 mm.

On the left side, the infundibulum receives the orifice of the frontal through its roof, and of the maxillary in its extension, just where it changes its direction from downward to downward and backward. The fossa behind the bulla receives the opening of the second anterior ethmoid cell at its lowest portion. The first anterior ethmoid cell, as has already been stated, opens into the maxillary. The three posterior ethmoid cells open into the superior meatus, two anterior to the anterior border of the second ethmoid turbinate, and two behind it. (The most anterior cell of this group has two openings, one anterior, the other posterior to the border.) The orifice of the sphenoid is entirely behind the second ethmoid turbinate.

The orifices of the maxillary sinus, the second anterior ethmoid, the small posterior ethmoid lying just above the maxillary, and the sphenoid are on a line but slightly inclined from the horizontal, the difference in level between the first and last of these being 5 mm. The opening of the most posterior ethmoid is 3 mm. below this, of the other posterior ethmoid 1 mm. above, and of the frontal 8 mm. above. The orifice of the maxillary sinus is 31 mm. above the highest level of the floor of the nose, 19 mm. above the level of the anterior extremity of the inferior turbinate, and 11 mm. above the lowest level of the anterior border of the first ethmoid turbinate. The orifices lie the following distances behind the anterior border of the first ethmoid turbinate; frontal 5 mm. maxillary 3 mm., second anterior ethmoid 8 mm., posterior ethmoid 13 mm., 17 mm., 19 mm., and 28 mm., respectively, and the sphenoid 29 mm. The naso-lachrymal canal is 3 mm. farther away. The distances from the anterior extremity of the inferior turbinate are as follows: frontal 19 mm., maxillary 17 mm., second anterior ethmoid 22 mm., posterior ethmoid 27 mm., 31 mm., 33 mm., and 41 mm., respectively, and the sphenoid 43 mm. The distances from the floor of the cranial fossa at the corresponding levels are as follows: frontal 13 mm., maxillary 23 mm., second anterior ethmoid 19 mm., posterior ethmoid 12 mm., 17 mm., 12 mm. and 16 mm., respectively, and the sphenoid 14 mm.

On the right side, the frontal opens on the roof of the infundibulum, the maxillary in the horizontal portion; the two upper anterior ethmoid cells open also into the infundibulum, as well as the cell constituting the upper portion of the bulla ethmoidalis. The cell constituting the lower portion opens into the fossa which extends downward from the infundibulum. The six posterior ethmoid cells open into the superior meatus, all but one being above the antero-inferior border of the superior turbinate. The sphenoid opens 7 mm. behind the posterior border of the second ethmoid turbinate.

The distances of the orifices from the highest level of the floor of the nose are as follows: frontal 31 mm., anterior ethmoid 35 mm., 38 mm. (two) and 32 mm., respectively; posterior ethmoid 29 mm., 27 mm. (three), 33 mm., 26 mm., respectively. maxillary 27 mm., sphenoid 25 mm. The distances above the level of the anterior extremity of the inferior turbinate are: frontal 30 mm., anterior ethmoid 26 mm., 29 mm. (two), 23 mm., respectively; posterior ethmoid 20 mm., 18 mm. (three), 24 mm., and 17 mm., respectively; maxillary 18 mm., and sphenoid 16 mm. Above the lowest level of the anterior border of the first ethmoid turbinate, the distances are: frontal 16 mm., anterior ethmoid 12 mm., 15 mm. (two), and 9 mm., respectively; posterior ethmoid 6 mm., 4 mm. (three), 10 mm., and 3 mm., respectively; maxillary 4 mm., sphenoid 2 mm. The orifices lie the following distances behind the anterior border of the first ethmoid turbinate; frontal 3 mm., anterior ethmoid 3 mm., 8 mm., 9 mm., and 10 mm. respectively; posterior ethmoid 15 mm., 19 mm., 21 mm. (two) 25 mm., and 28 mm., respectively; maxillary 8 mm., and sphenoid 35 mm. The naso-lachrymal canal is 1 mm. farther away. The distances from the anterior extremity of the inferior turbinate are 7 mm. greater.

CONCLUSIONS.

The method of study here presented and carried out in detail on the head described, gives an accurate picture of the different diameters of the sinuses shown by reconstructions, anteriorly, superiorly and laterally. It is possible through this to obtain the distances of the sinuses from more or less fixed and accessible structures in or about the nose.

The error is reduced to a minimum, being no greater than that which follows from the grossness of all macroscopic measurements in connection with the human body. All measurements are thus subject to an error of 1 millimeter, far less than can not be noted by the eye except under the most favorable circumstances.

While the method deals particularly with the greatest diameters of the sinuses, it may be utilized to reconstruct any portion of an organ large or small. In this way, a study may be made of special details, without reference to the complete reconstructions. By no other method can comparisons in the shape or position of the sinuses be so accurately made. For here we have any plane or the composite plane fixed in such a manner that comparisons may be made by superimposing one projection upon the other. It is just as easy to reconstruct one wall of a sinus as all the walls, hence, one may choose his own problem in this connection.

The preparations from which these reconstructions are made, are not destroyed, but preserved, so they may be used for control, study and comparisons for other methods as well as this.

A series of heads reconstructed in the manner indicated will certainly give valuable information as to the character of the variations of the sinuses, and their relations with one another and other structures. It will be easy, when a sufficient number of heads have been reconstructed, to draw a composite of the sinuses, showing their average shape, position and relations.

Grateful acknowledgment is made to Dr. Peter Potter, for his cordial advice and assistance in the beginning of this work, and to Miss Alice Ethel Hamilton, who has so faithfully executed the drawings and assisted in the reconstructions.

DESCRIPTION OF PLATES.

Plate 1.—1. Right frontal sinus; 2. Left frontal sinus; 3. Roof of orbit; 4. Superior longitudinal sinus; 5. Falx cerebri; 6. Fissure of Sylvius; 7. Island of Reil; 8. Frontal operculum; 9. Anterior horn of lateral ventricle; 10. Posterior horn of lateral venticle; 11. Optic thalamus.

Plate II.—1. Right frontal sinus; 2. Anterior ethmoid cell; 3. Left frontal sinus; 4. Anterior ethmoid cells displacing anterior wall of the frontal sinus; 5. Crista galli; 6. Fissure of Sylvius; 7. Eye muscles; 8. Lachrymal gland; 9. Superior longitudinal sinus; 10. Lateral ventricle; 11. Third ventricle; 12. Pineal gland; 13. Aqueduct of Sylvius; 14. Opening into pituitary body and foramina of Munro.

Plate III.—1. Naso-lachrymal canal; 2. Infundibulum; 3. Anterior ethmoid cells; 4. Anterior ethmoid cell which replaces anterior wall of the frontal sinus; 5. Posterior ethmoid cells; 6. Left sphenoid sinus lying above the right; 7. Optic nerve; 8. Descending horn of lateral ventricle; 9. Pons; 10. Cerebellum; 11. Superior longitudinal sinus.

Plate IV.—1. Naso-lachrymal canal; 2. First ethmoid turbinate; 3. Maxillary sinus; 4. Sphenoid sinus; 5. Fifth nerve and Gasserian ganglion; 6. Temporo-sphenoidal lobe; 7. Cerebellum; 8. Lateral sinus; 9. Fourth ventricle; 10. Pons; 11. Internal carotid artery.

Plate V.—1. Maxillary sinus; 2. Nasal septum; 3. Inferior turbinate; 4. Temporomaxillary articulation; 5. External auditory canal; 6. Mastoid cells; 7. Lateral sinus; 8. Middle ear; 9. Internal carotid; 10. Semicircular canals; 11. Cerebellum; 12. Medulla; 13. Eustachian tube; 14. Fourth ventricle; 15. Basilar artery.

Plate VI.—1. Pharynx; 2. Maxillary sinus; 3. Roots of teeth; 4. Parotid gland; 5. Mastoid cells; 6. Lateral sinus; 7. Jugular; 8. Internal carotid; 9. Cerebellum; 10. Medulla.

Plate VII.—The sinuses with their orifices, the infundibulum, the cranial cavity, turbinate, naso-lachrymal canal and floor of the nose of the left side are shown as they are reconstructed on millimeter paper, the sinuses and infundibulum being represented by solid lines and the other structures by broken lines.

Plate VIII.—Left lateral reconstruction. In this and Plates IX, X and XI the frontal sinus is colored yellow, the maxillary purple, the sphenoid green and the ethmoid red, the anterior group being lined horizontally and the posterior group perpendicularly. The ethmoid cells are to be noted in two groups, the anterior, three in number, and the posterior, two. The first anterior cell is shown displacing the anterior wall of the frontal and opening into the maxillary sinus. The frontal is seen opening into the infundibulum. The antero-inferior wall of the second ethmoid cell constitutes the bulla ethmoidalis (posterior boundary of the infundibulum).

Plate IX.—Anterior reconstruction. On account of the multiplicity of lines, the individual ethmoid cells are not shown; however, the two groups are represented, the anterior being lined horizontally and the posterior perpendicularly. The left sphenoid sinus lies far above the right; its inner wall extends almost as far to the right as the outer wall of the right sphenoid sinus.

Plate X.—Right lateral reconstruction. The frontal sinus is seen opening into the infundibulum, its inferior wall only being encroached upon by the ethmoid cells. There are four cells belonging to the anterior group of ethmoid cells and five to the posterior. The bulla ethmoidalis is formed by the anterior wall of the two most posterior anterior ethmoid cells.

Plate XI.—Superior reconstruction. The right sphenoid sinus extends almost as far to the left as the left does to the right, while the right lies much more posterior and the left much more anterior. The difference between the right and the left ethmoid cells is well shown.

Plate XII.—Lateral reconstruction; in this and Plates XIII and XIV the sinuses of the right side are colored green and the left yellow. F, frontal; A. E., anterior ethmoid; P. E., posterior ethmoid; S., sphenoid; M., maxillary.

Plate XIII.—Anterior reconstruction; F., frontal; A. E., anterior ethmoid; P. E., posterior ethmoid; S., sphenoid; M., maxillary.

Plate XIV.—Superior reconstruction; F., frontal; A. E., anterior ethmoid; P. E., posterior ethmoid; S., sphenoid; M., maxillary.

XV.—Left lateral reconstruction showing the orifices of the sinuses in relation to the turbinates, infundibulum, cranial cavity and naso-lachrymal canal.

XVI.—Right lateral reconstruction showing orifices of the sinuses in relation to the turbinates, infundibulum, cranial cavity and naso-lachrymal canal.

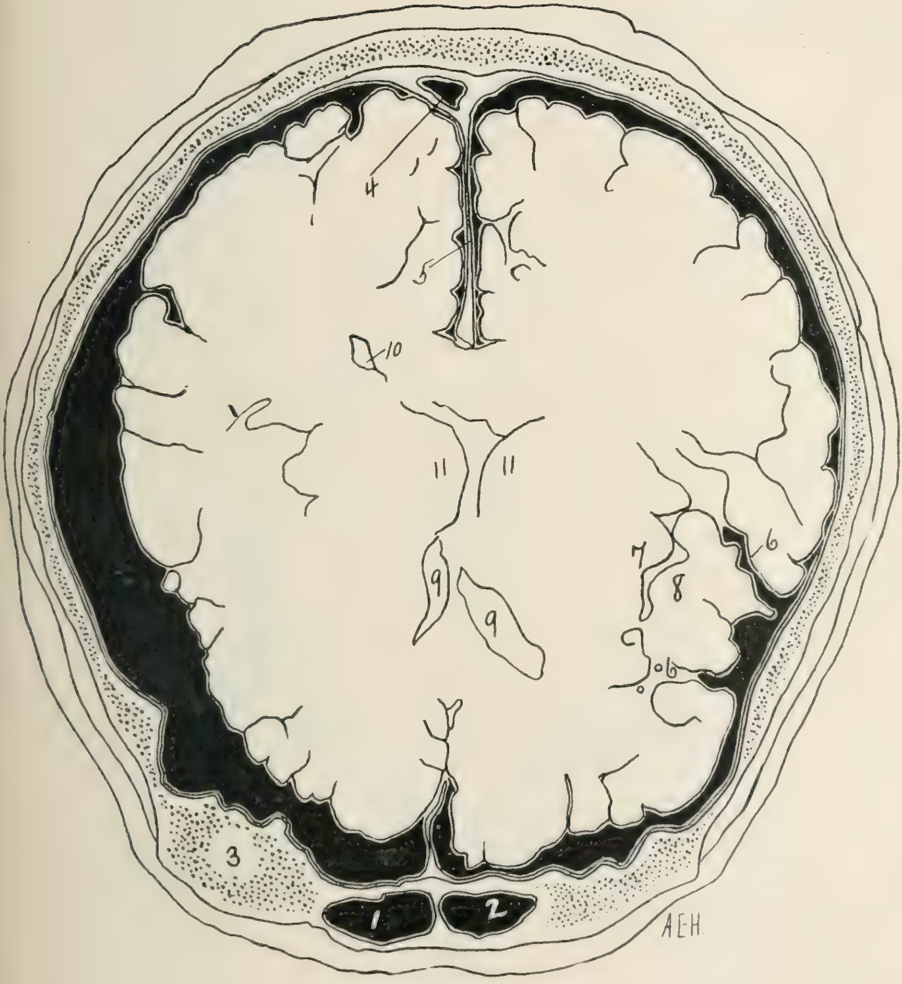


PLATE I.

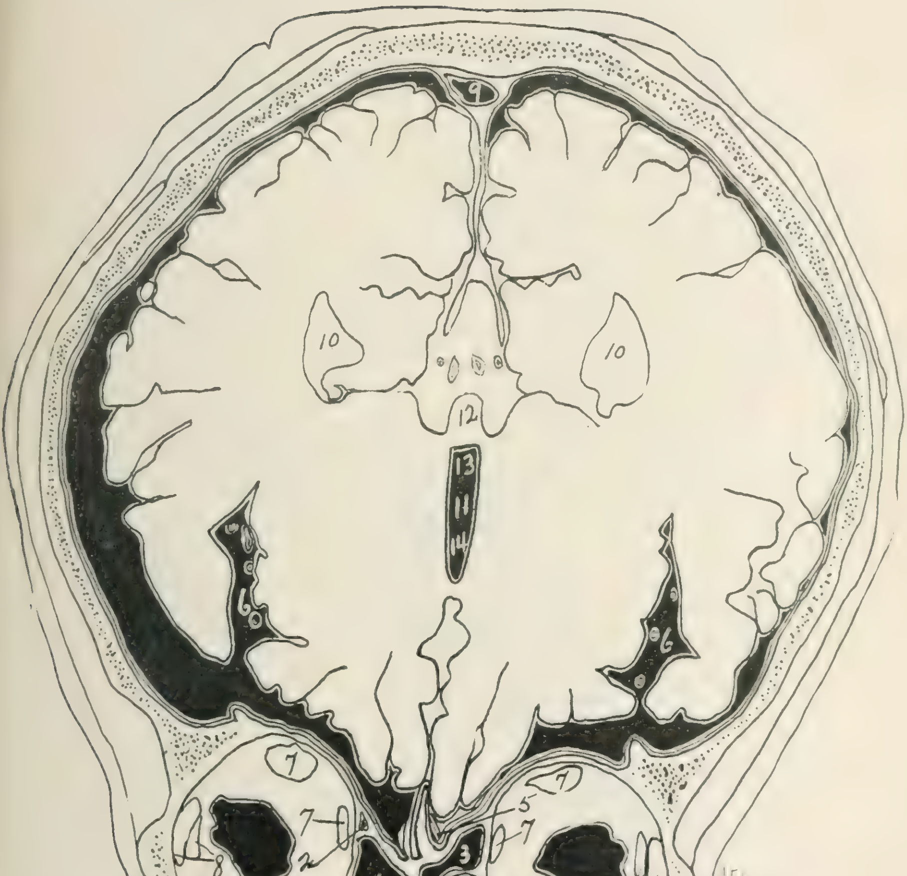


PLATE II.

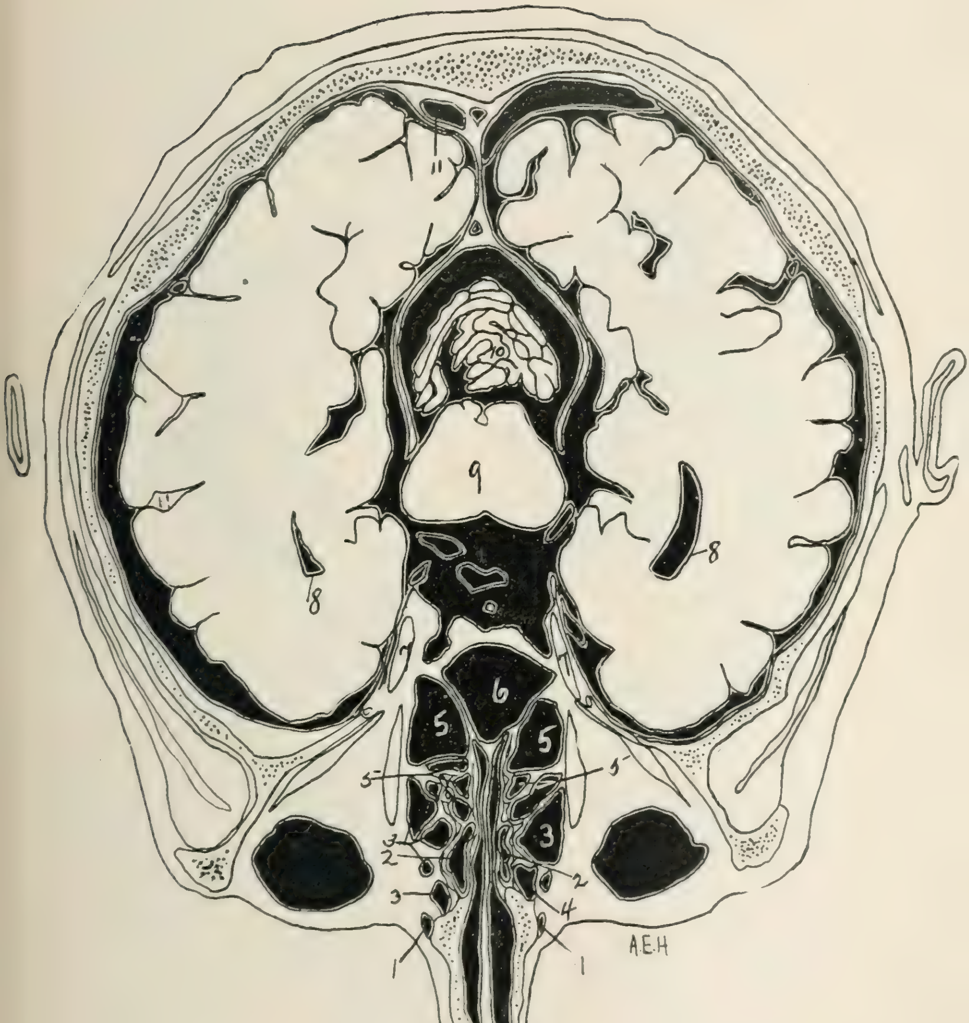


PLATE III.

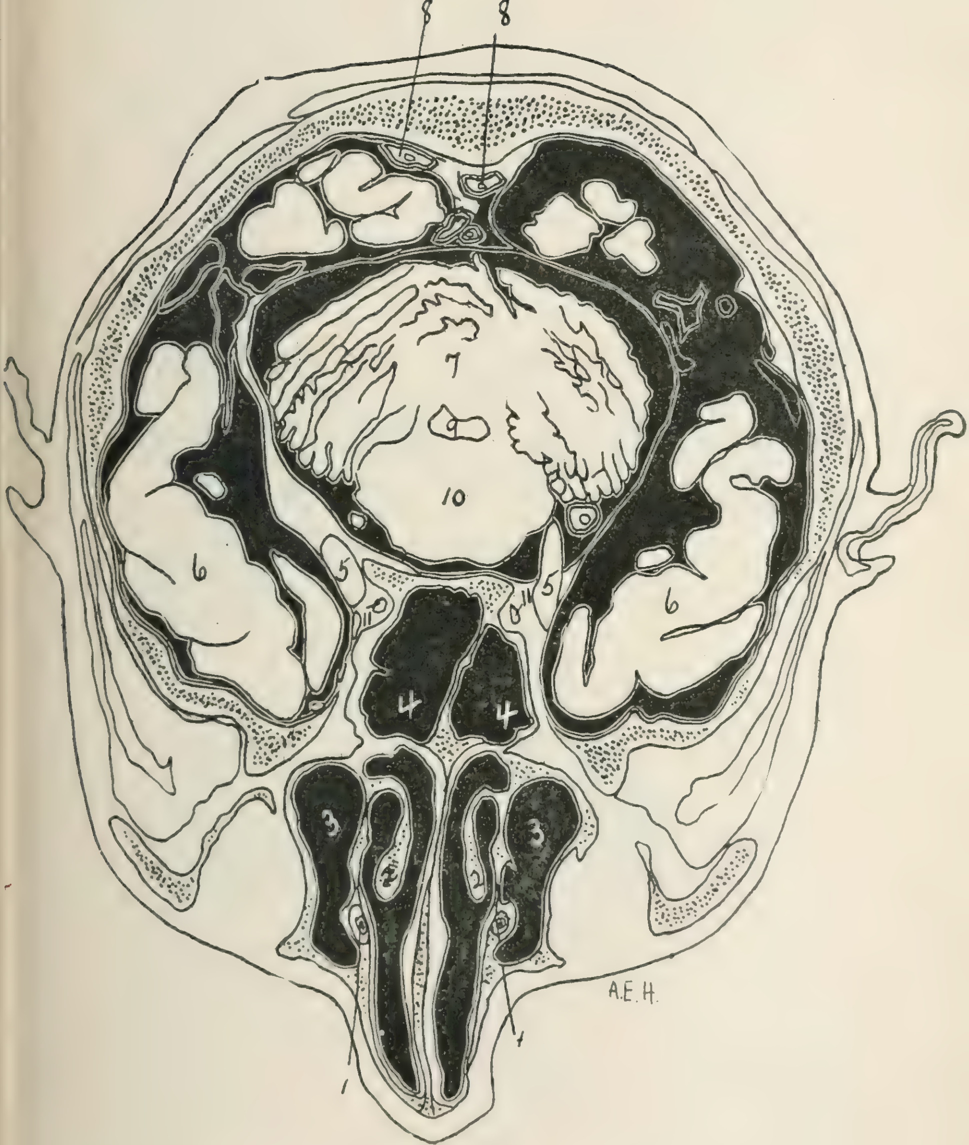


PLATE IV.

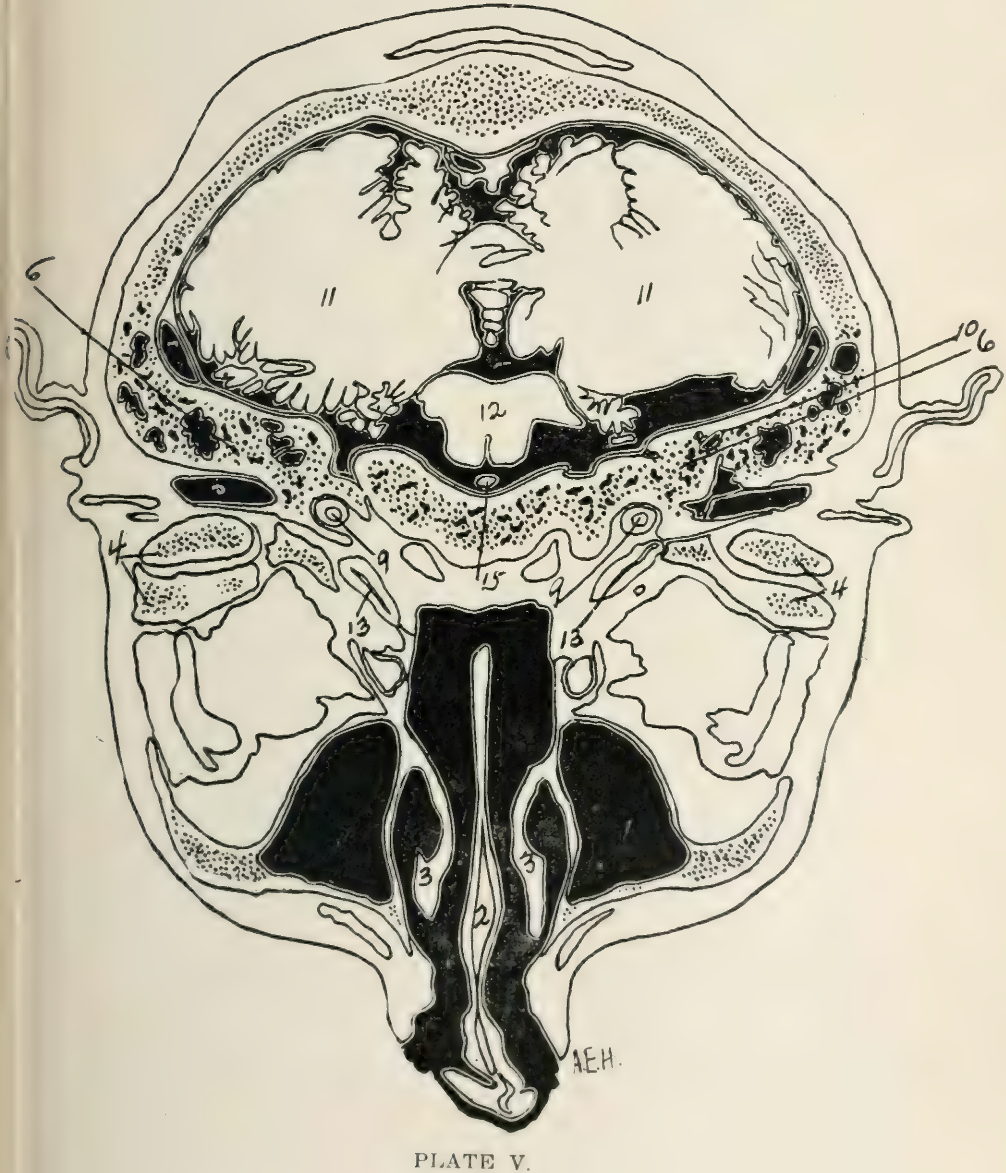


PLATE V.

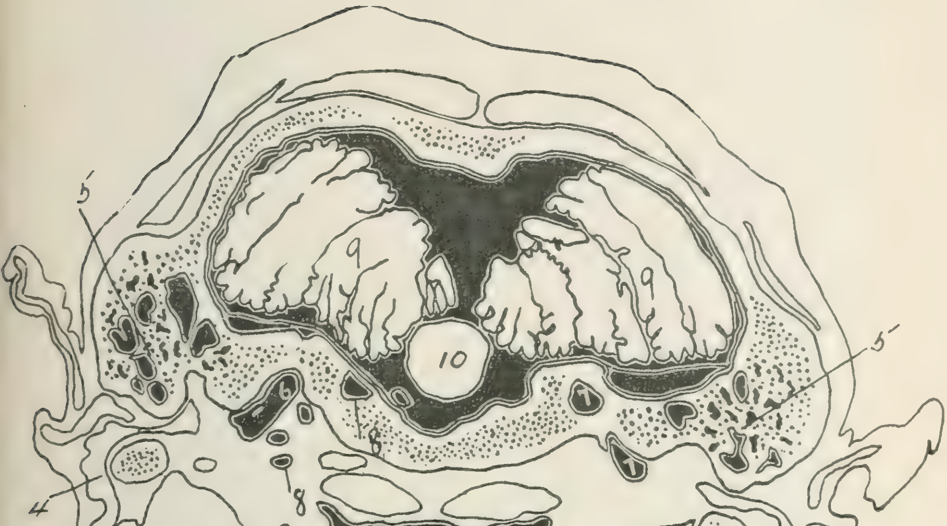


PLATE VI.

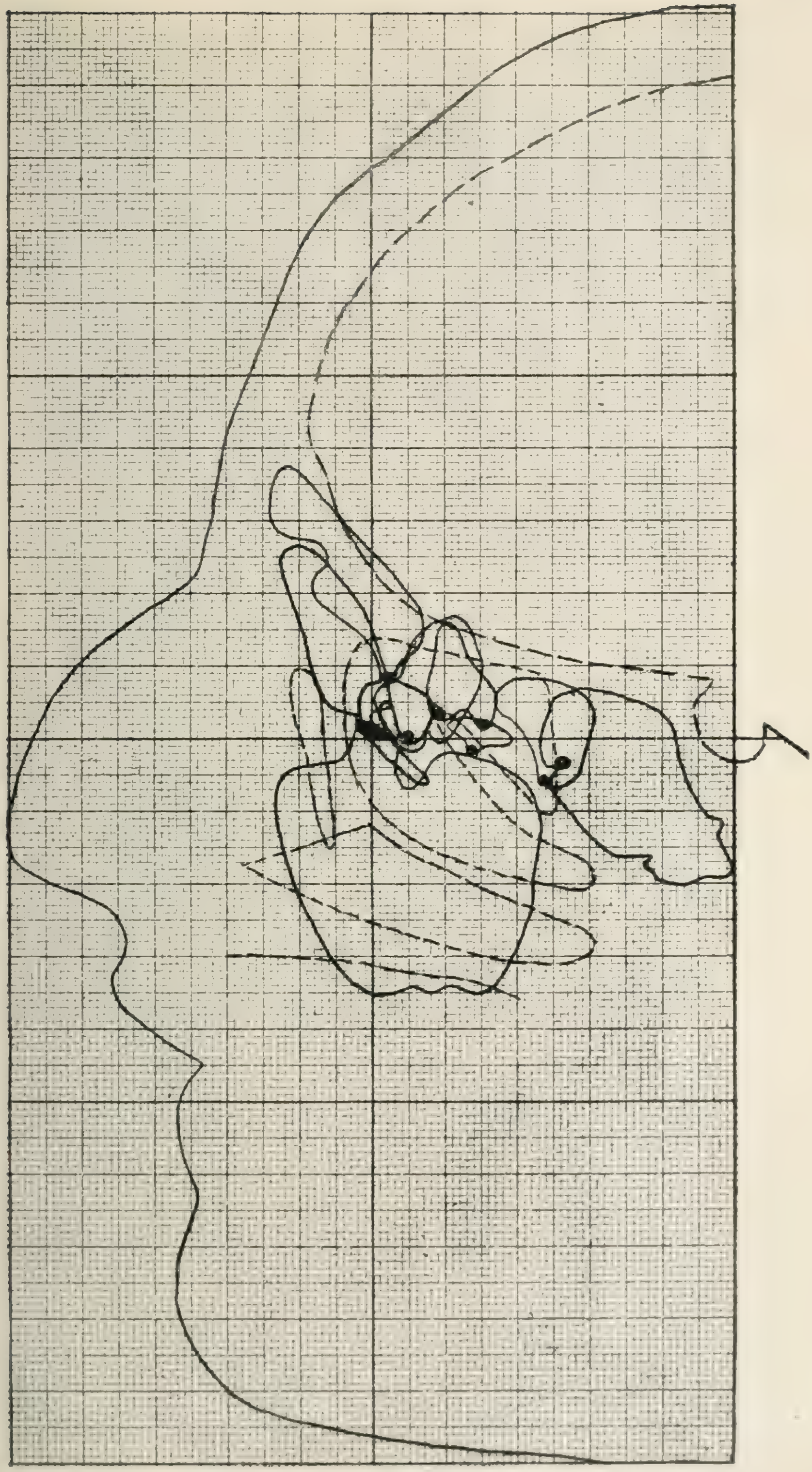


PLATE VII.

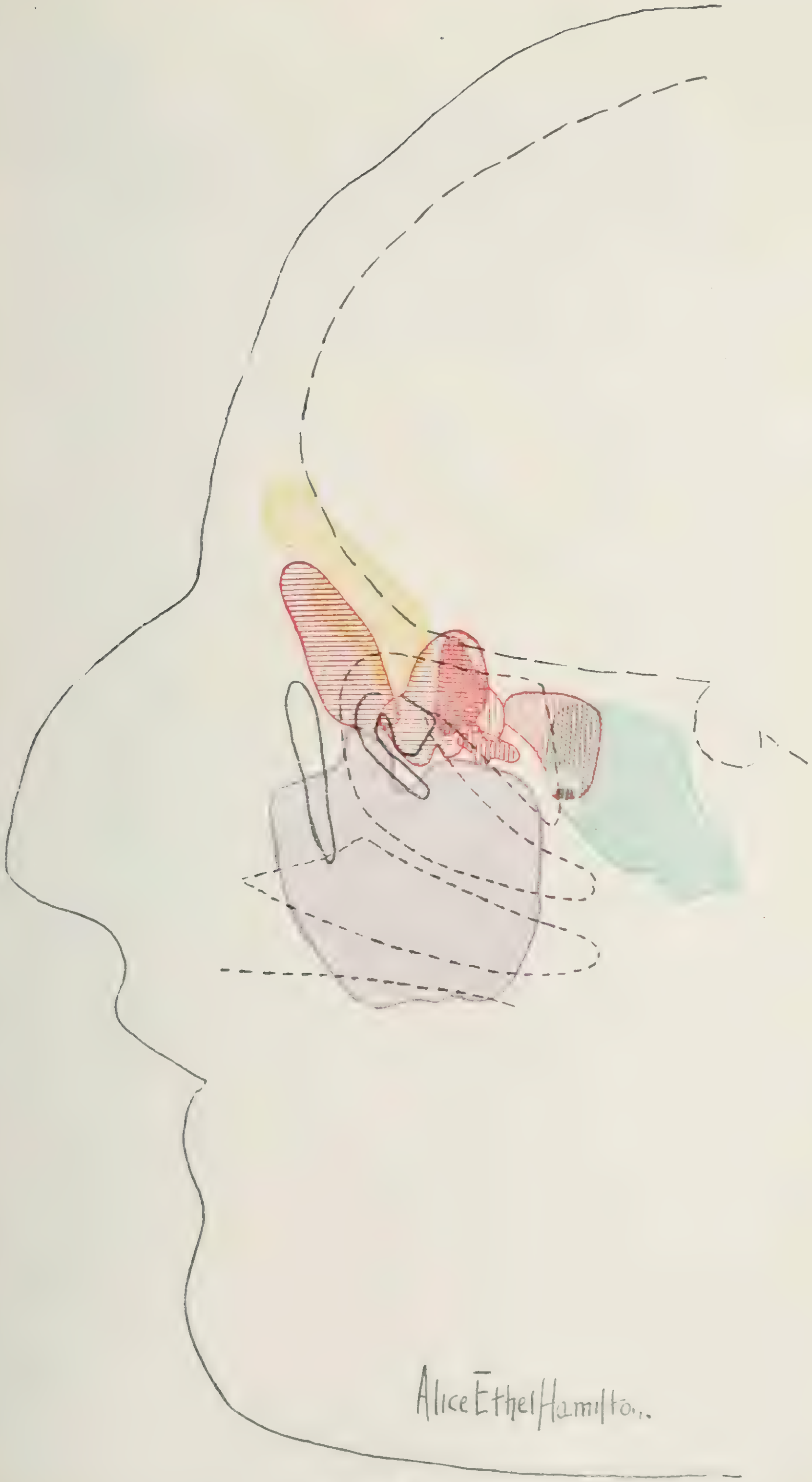


PLATE VIII.

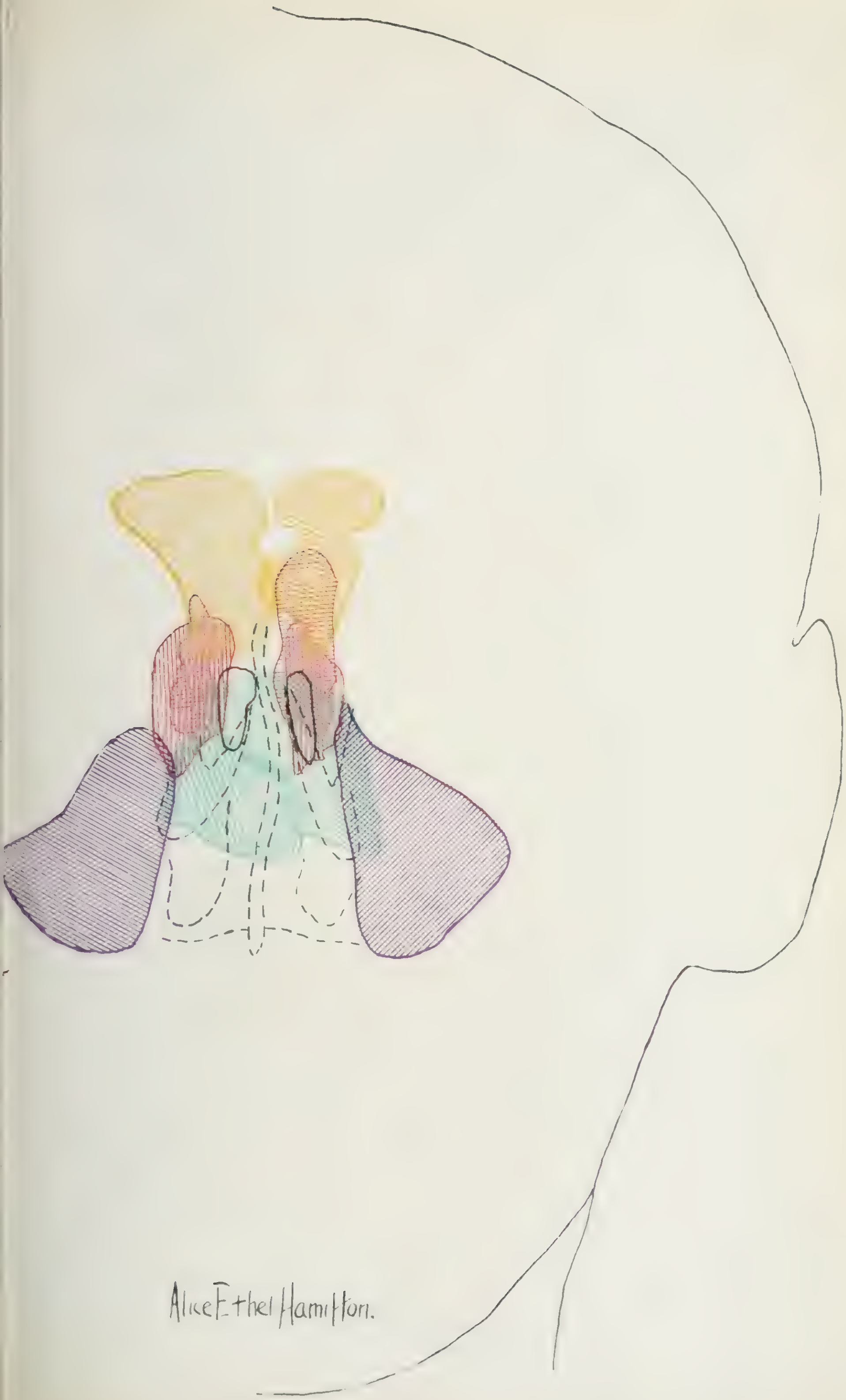


PLATE IX

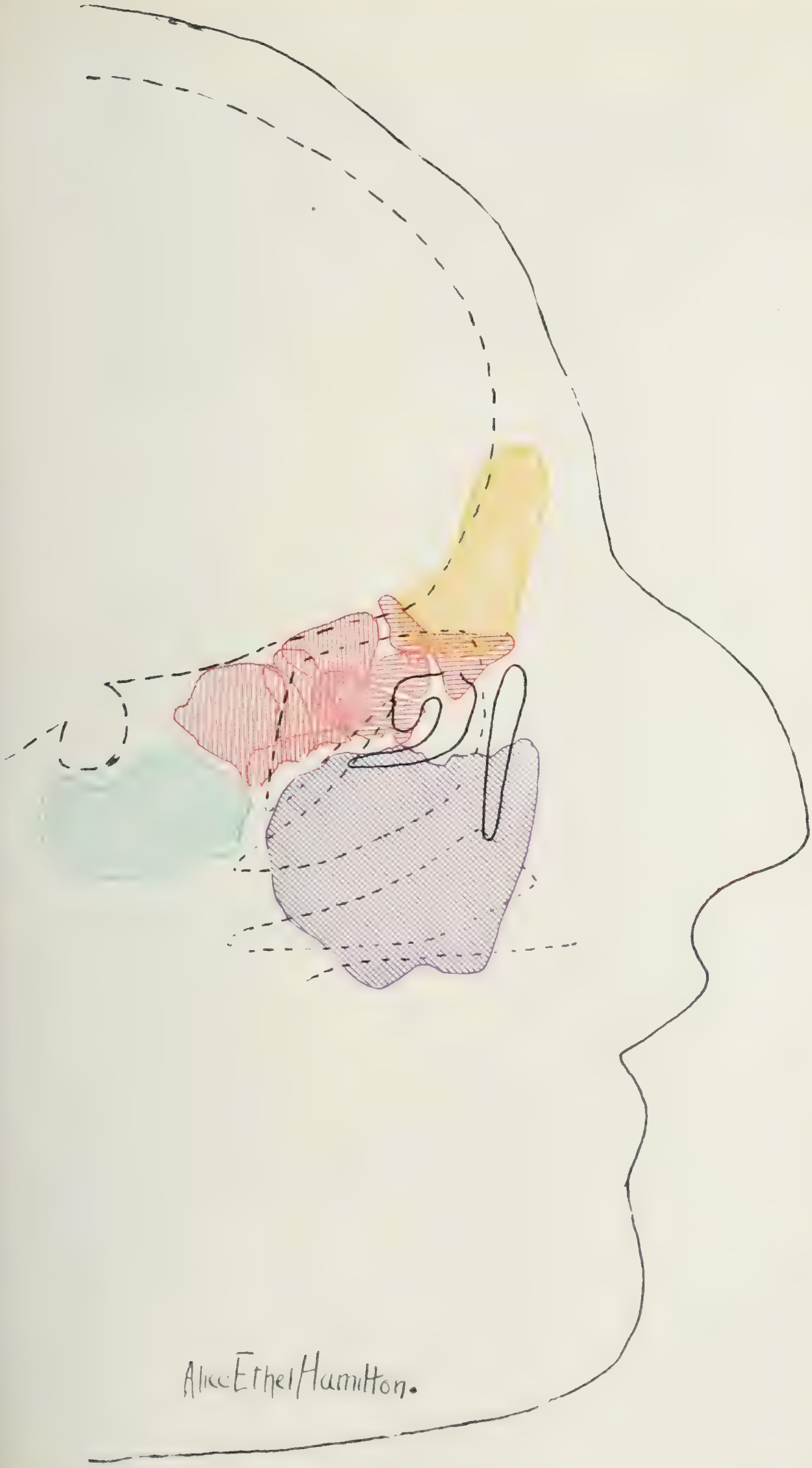
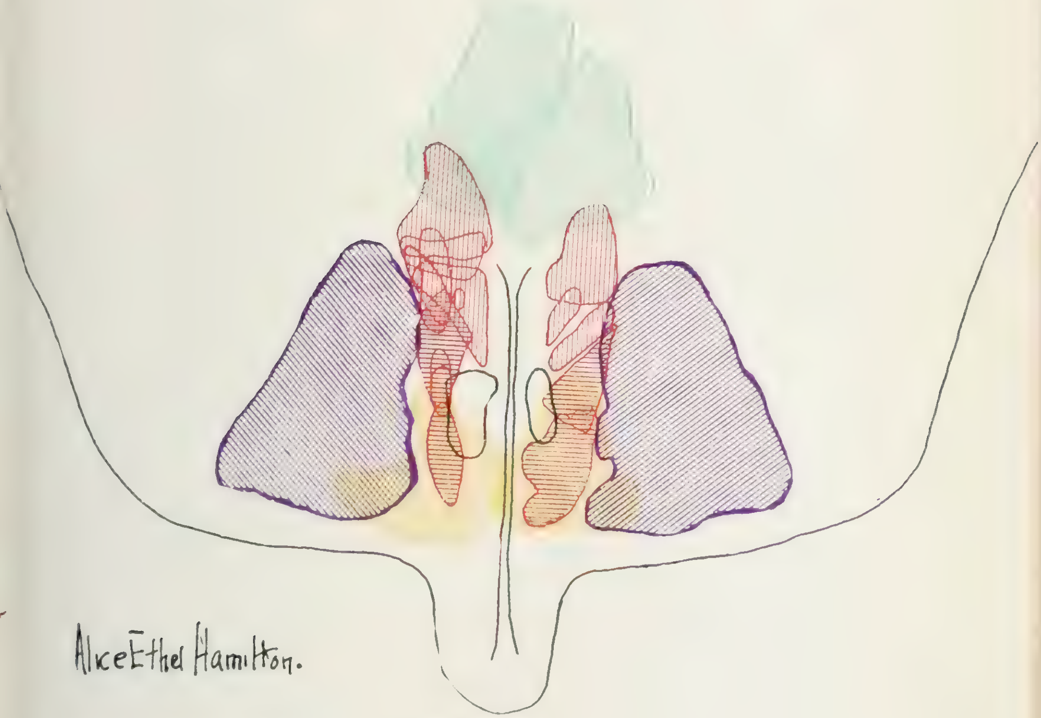


PLATE X.



Alice Ethel Hamilton.

PLATE XI.

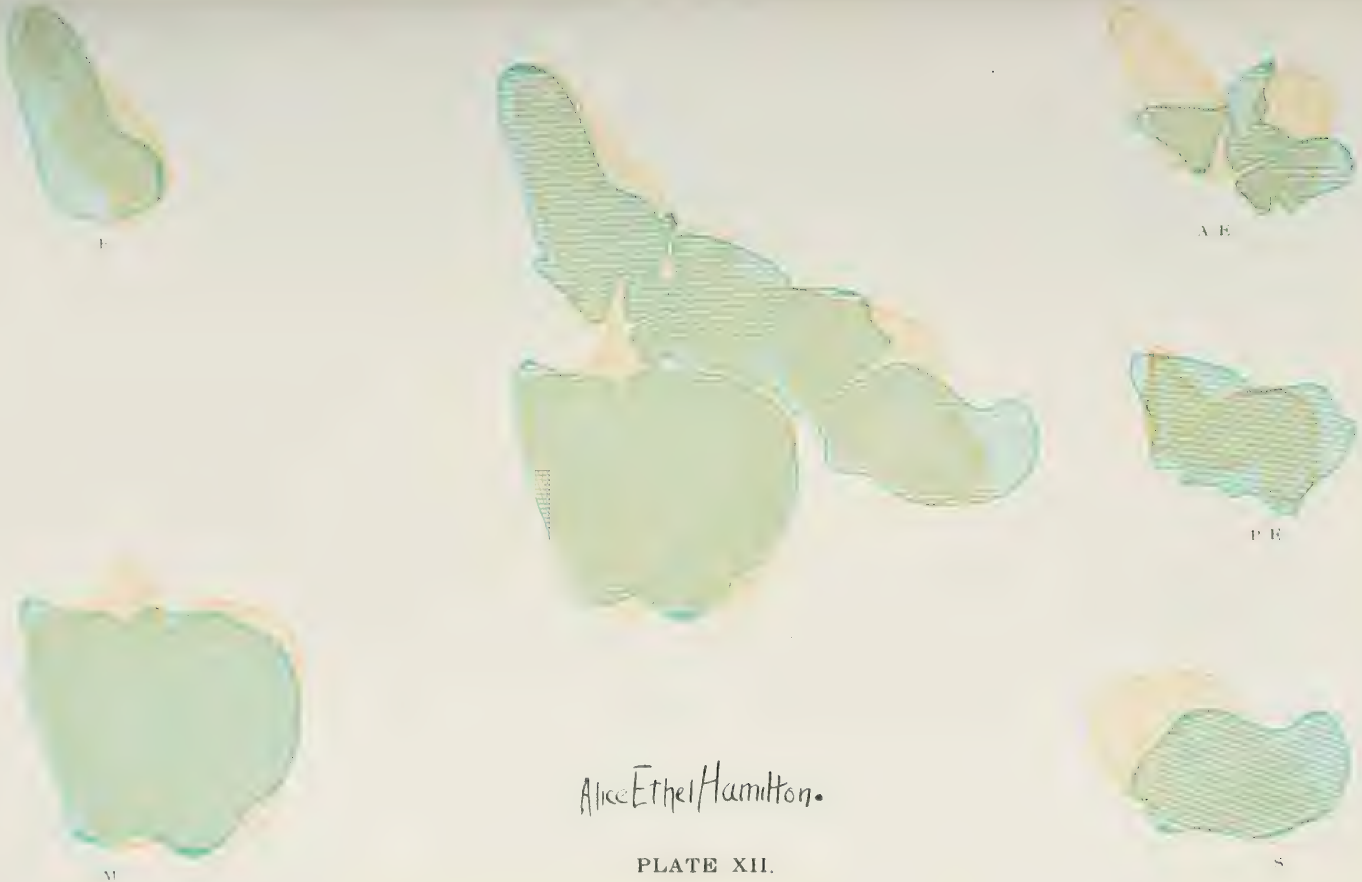


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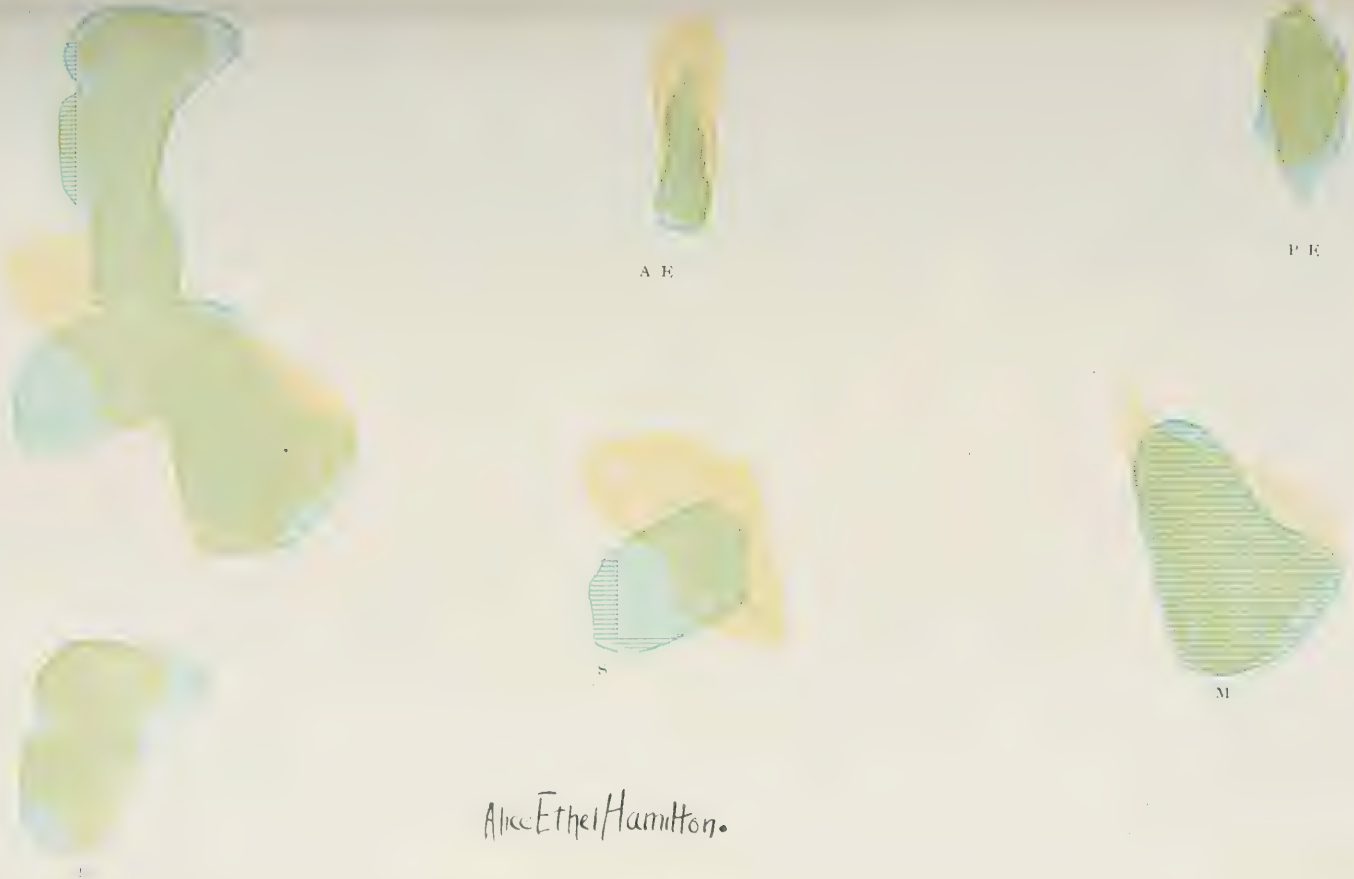
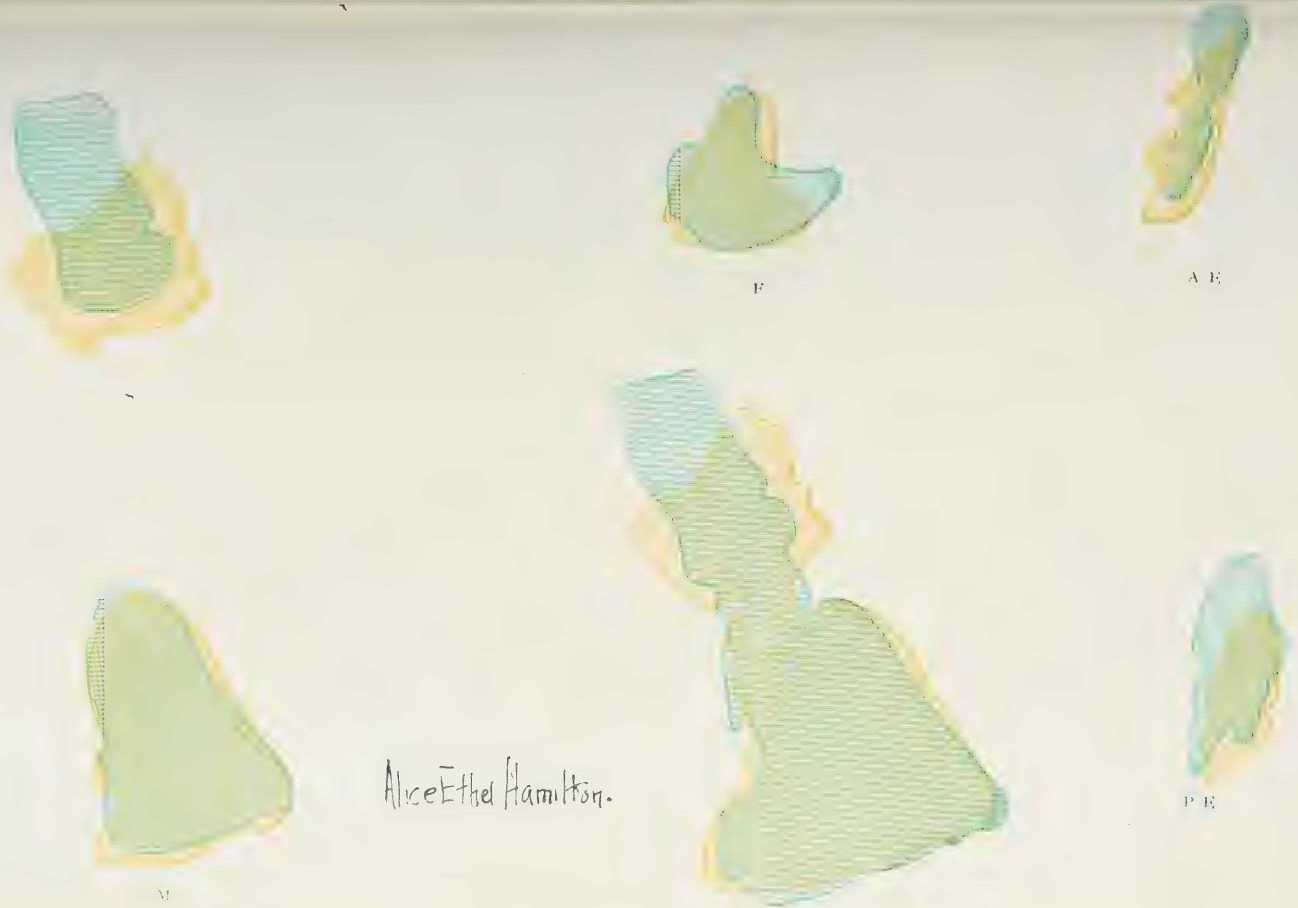
PLATE XII.



Alice Ethel Hamilton.

PLATE XIII.



Alice Ethel Hamilton.

PLATE XIV.

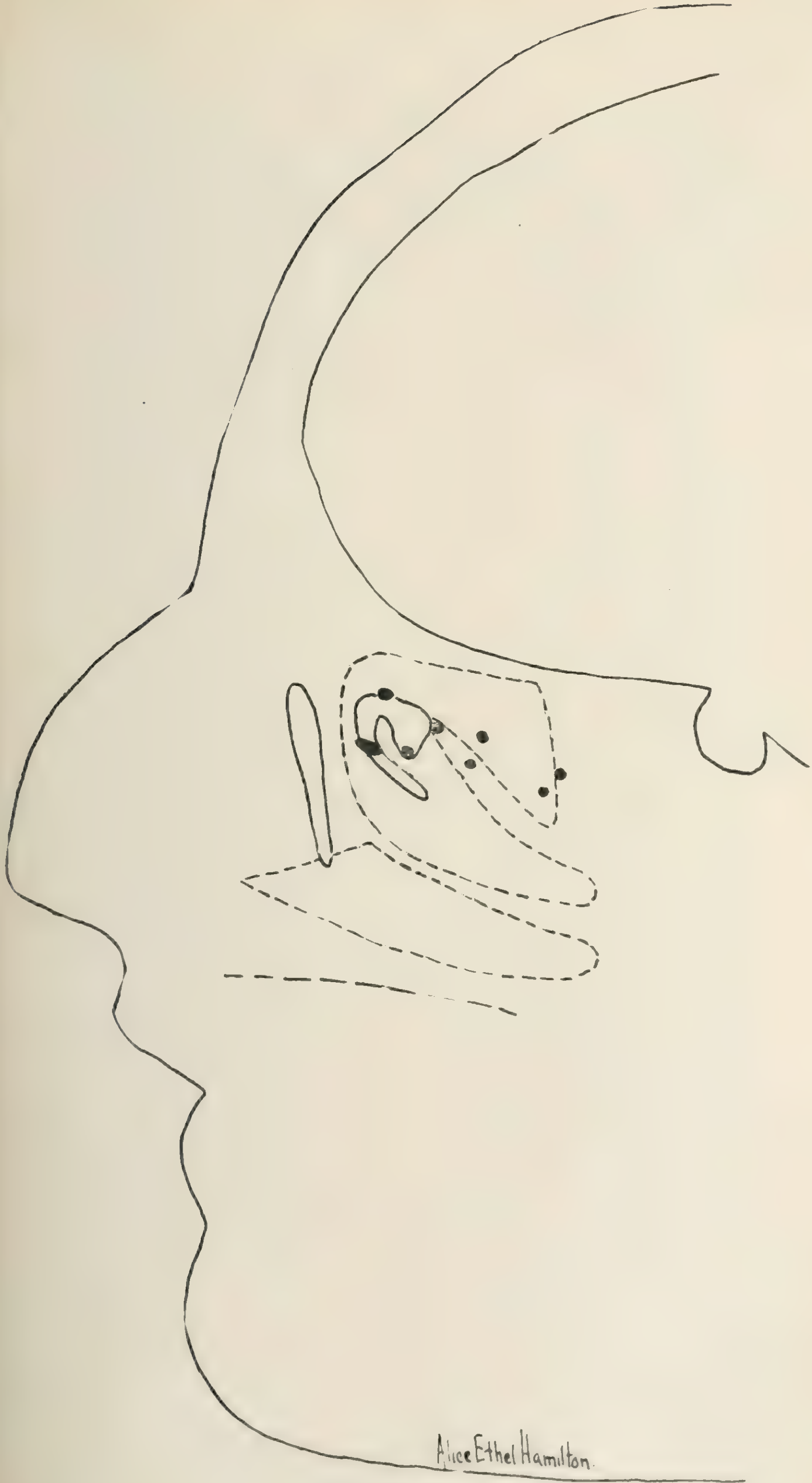


PLATE XV.

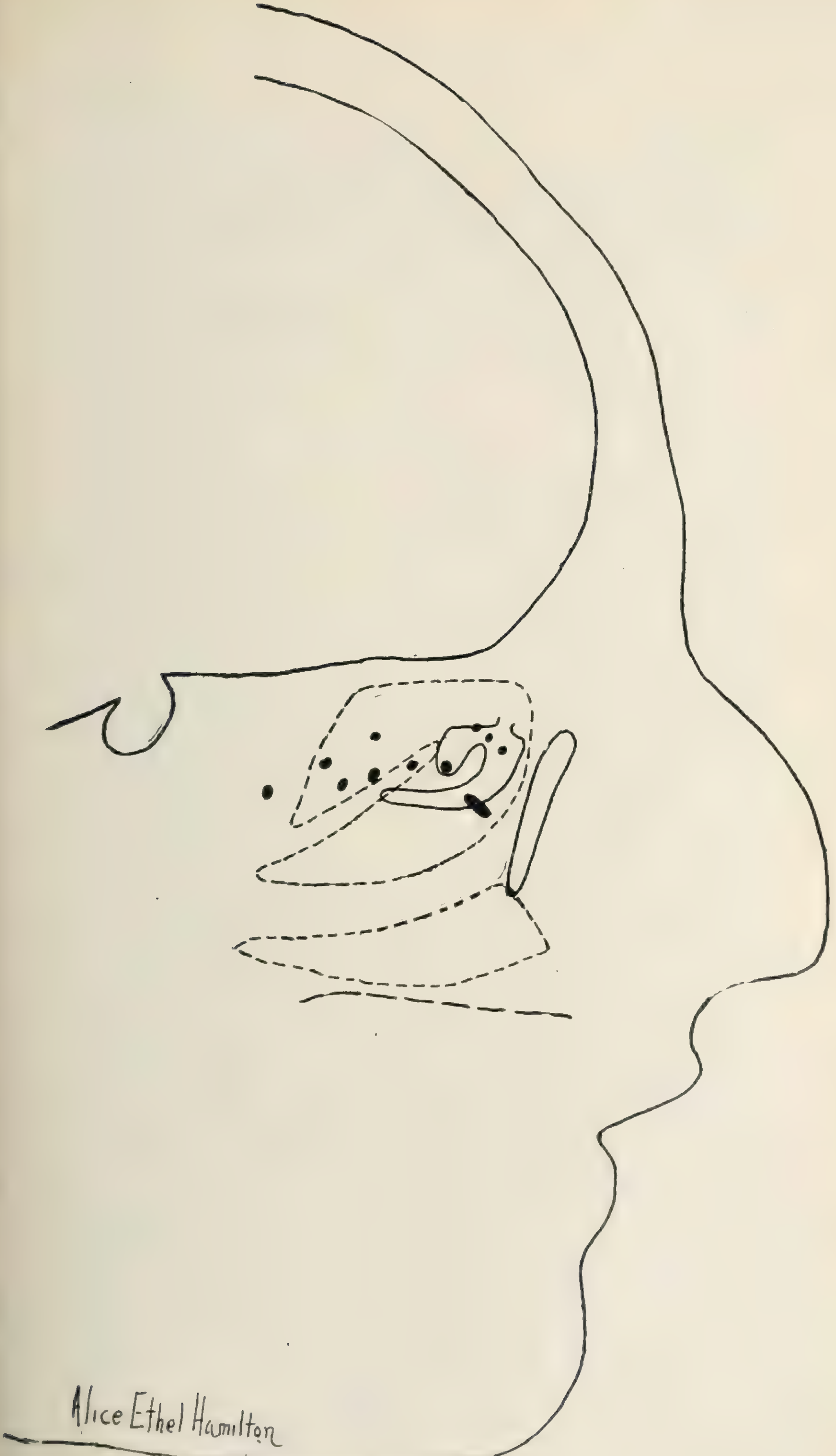


PLATE XVI.

LIII.

THE FUNCTION OF THE ACCESSORY CAVITIES OF THE NOSE.*

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The functions of most of the organs of the body are so well known that, with our present knowledge, these functions seem almost self-evident. There are, however, some organs which are apparently functionless and are usually considered vestigial or rudimentary. They were formerly of greater physiologic importance, but in the course of generations, in consequence of adaptation of the body to special conditions of life, they have been subjected to reduction or degeneration and now remain simply as vestiges. Their presence can be explained only by the theory of selection, and in this connection, two important factors must be considered, namely, heredity and the capability of variation.

Heredity is conservative and tends to retain the ancestral characters. The capability of variation is influenced by external conditions and results in the modification of structures. The resulting adaptations as far as they are useful to the organism concerned, are transmitted to future generations. Thus heredity and adaptation are parallel factors, and the knowledge of this fact helps us to explain the presence of various rudimentary organs in the adult.

With these general principles in mind, the study of the comparative anatomy of the accessory cavities of the nose, should teach us what their function has been and whether or not they are now functionally active in man.

Fishes.—In fishes there are no accessory cavities of the nose. Their nose is a simple sack-like structure and does not communicate with the mouth, except in Dipnoi.

Dipnoi are fishes which live in shallow streams, and while in the water breathe through their gills as other fishes do.

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*Read at the Meeting of the American Laryngological, Rhinological and Otological Society, Kansas City, June, 1906.

Their nose communicates with the mouth, and they have a functional lung and resemble reptiles in some other respects. In the dry season, they live in the mud and breathe through their nose, and thus the nose becomes a part of the respiratory system.

REPTILES.—In reptiles the nasal cavities are more complicated. Each nasal fossa is divided in a general way, into a respiratory portion, situated anteriorly, and an olfactory portion, situated in the posterior superior part of the nose. This olfactory region contains the sensory nerve cells, and a rolled turbinal springs from its outer wall.

BIRDS.—In birds the turbinals all show a higher degree of development. Their form varies greatly; some are simple prominences and some are decidedly scroll shaped or even present a double coil, the superior coil making one complete turn and the inferior coil making two or more turns within itself.

There are no accessory cavities of the nose, but the bones of the skull, like some of the other bones in birds, contain large air cells or cavities to make the bones lighter.

MAMMALS.—In mammals, the turbinals and the nasal accessory cavities exhibit great variations, each showing a high or low degree of development, according to the environment of the animal.

KANGAROO (Macropus.)—The kangaroo occupies quite a low position in the mammalian scale, but its nose is much more highly developed than the nose in any of the birds.

The nasal fossae are two symmetrical cavities completely separated from each other in the median line by the septum. The maxillary turbinals correspond to the inferior turbinals in man. There is one in the anterior part of each fossa. Each one projects outward and upward from the maxillary bone, beginning as a thin shelf-like process which divides into numerous curved branches partially filling the anterior half or respiratory portion of the nose (Plate I, Figures A and B, 2). The function of the maxillary turbinals is to prepare the inspired air for respiration.

The posterior part of the vomer gives off two lateral wings, one on each side, which extend across the nasal fossae and unite with the ethmoidal bones, thus dividing each fossa posteriorly into two superimposed cavities (Plate I, Figures C and D, 6). The superior cavities contain most of the ethmoidal turbinals and constitute the olfactory portion of the nose. The inferior cavities are tube-like structures and form a direct communication between the anterior or respiratory portion of the nose and the nasopharynx (Plate I, Figures C and D, 7).

There are five ethmoidal turbinals in each fossa. They spring from the convex surface of the cribriform plate of the ethmoidal bone and give off numerous branches which extend anteriorly into the nose. Some of them articulate with and are supported by the frontal, nasal and superior maxillary bones, but none of them unite with the septum (Plate I, Figures B, C and D, 3). The numerous branching and curved processes of the ethmoidal turbinals are all covered by olfactory mucous membrane and thus a large surface is exposed in a comparatively small area. The function of the ethmoidal turbinals is olfactory.

The maxillary sinuses are simple diverticula between the anterior inferior parts of the ethmoidal turbinals and the superior maxillary bones (Plate I, Figure C, 5). They can hardly be called sinuses, but are rather large channels which lead from the respiratory portion of the nose to the external portion of the ethmoidal turbinals and thus bring a large olfactory surface in direct communication with the inspired air.

The ethmoidal cells are spaces between some of the branches of the ethmoidal turbinals and the adjacent bones of the skull (Plate I, Figures B and C, 4). They communicate directly with the maxillary sinuses and thus conduct the air over a still greater surface of the olfactory turbinals.

There are no frontal or sphenoidal sinuses in the kangaroo's skull. Thus in the kangaroo, the olfactory or ethmoidal turbinals are situated in the posterior superior part of the nose. Their internal surfaces are exposed directly to a part of the inspired air after it has passed through the branches of the maxillary turbinal. The maxillary and ethmoidal sinuses; which are the only ones present in the kangaroo, serve as channels to conduct some of the inspired air over the external lateral surfaces of the ethmoidal turbinals and so expose these portions of the olfactory turbinals more directly to the inspired air and are, therefore, functionally active in increasing the acuteness of the sense of smell.

Deer (Cervus).

A longitudinal section through the deer's head shows three ethmoidal turbinals (Plate II, Figure A, 2), and a large maxillary turbinal (Plate II, Figure A, 1), all of which present comparatively smooth surfaces. Transverse sections through these turbinals show them to be highly developed and very complicated structures.

The maxillary turbinal is a double coil. It springs from the superior maxillary bone as a thin shelf-like process, parallel to the floor of the nose, extending two-thirds of the way across the fossa. It then divides into two processes, the superior one makes three complete turns within itself and the inferior one makes two turns (Plate II, Figures B, C, D and E, 1).

There are three ethmoidal turbinals (Plate II, Figures A, C, D, E, F and G, 2). They arise from the convex surface of the cribriform plate of the ethmoidal bone, and at first consist of a mass of thin, delicate curved branches which intertwine with each other and almost completely fill the posterior superior part of each fossa (Plate II, Figure G, 2). As these branches extend anteriorly, they decrease in number and present broader and less convoluted surfaces (Plate II, Figure F, 2). The ethmoidal cells are cavities contained within these broader branches or between these branches and some of the surrounding bones of the skull (Plate II, Figure F, 7). The frontal sinuses are comparatively small cavities between the plates of the frontal bones and are partially filled by scrolls of the ethmoidal turbinals.

The maxillary sinuses are large cavities in the superior maxillary bones (Plate II, Figure F, 6). Their ostia are situated in the posterior part of each cavity and open into the nose in conjunction with some of the ethmoidal cells. Some processes of the ethmoidal turbinals extend into the maxillary sinuses.

In the deer, the accessory sinuses are more circumscribed and more definitely separated from the rest of the nasal fossae than they are in the kangaroo, but the sinuses all contain ethmoidal turbinal tissue and are a part of the olfactory portion of the nose.

Prairie Wolf (Canis latrans).

The wolf's nose is more highly developed than the nose of the kangaroo or the deer. The turbinals are all much more complicated and their branches are more numerous and convoluted so that the inspired air is brought in contact with a tremendous expanse of mucous membrane.

The anterior half of each nasal fossa is almost completely filled with the fine branches of the maxillary turbinal (Plate III, Figures A and B, 1). The lateral wings of the vomer divide the posterior portion of each nasal fossa into an olfactory and respiratory part as in the kangaroo and the deer (Plate III, Figures A, C and D, 17).

In each fossa there are seven ethmoidal turbinals radiating from the convex surface of the cribriform plate and their delicate intertwining scrolls form a dense labyrinth in the olfactory part of the nose (Plate III, Figures A, C and D, 2). They articulate with the lateral wings of the vomer, the superior maxillary, frontal and nasal bones.

The maxillary sinus (one in each fossa) is an irregularly oval cavity between the ethmoidal turbinals and the superior maxillary bone (Plate III, Figures C and D, 11). Its posterior part is entirely shut off from the nasal fossa by the ethmoidal bone but anteriorly it is only partially separated from the nose by some scrolls of the ethmoidal turbinal. It acts as a channel to conduct some of the inspired air over the external lateral surface of the olfactory turbinals and thus produces a keener sense of smell. It is therefore, a part of the olfactory portion of the nose.

The ethmoidal cells are irregular spaces between the ethmoidal turbinals and the surrounding bones of the skull and contain scroll-shaped branches of the ethmoidal turbinal which spring directly from the cribriform plate (Plate III, Figure A, 4),

There is one frontal sinus in each half of the skull. It is an irregular cavity between the two plates of the frontal bone (Plate III, Figure A, 6). Anteriorly it communicates directly with the ethmoidal cells and contains a double coil of the ethmoidal turbinal.

The sphenoidal sinus is simply a slight depression in the anterior part of the sphenoidal bone and is filled by an ethmoidal turbinal scroll.

All the accessory sinuses of the nose in the wolf are therefore a part of the olfactory portion of the nose and all contain olfactory turbinal tissue. Their function is to conduct the air over a part of the olfactory turbinals which would not be otherwise directly exposed to the inspired air, and thus increase the acuteness of the sense of smell.

APES. Indian Ape (Macacus rhesus).

The ape's nose is a very much degenerated structure. The maxillary turbinal is a slightly curved bone and is very similar in outline and position to the corresponding turbinal in man (Plate IV, Figure B, 1). There are two ethmoidal turbinals in each fossa (Plate IV, Figures A, B and C, 2 and 3). The larger one projects downward and forward from the ethmoidal bone and divides into two branches (Plate IV, Figures A, B and C, 2). The smaller one is more scroll-shaped but both of these turbinals have lost the numerous, fine, convoluted branches which are present in lower animals, and the other ethmoidal turbinals (third, fourth and fifth) have entirely disappeared.

The maxillary sinus is situated within the maxillary bone and opens into the middle meatus through a small ostium, considerably above the floor of the sinus. Its walls are smooth and it contains no ethmoidal turbinal tissue (Plate IV, Figures A, B and C, 10). The other accessory sinuses of the nose have disappeared completely and the space which they occupied in the frontal and sphenoidal bones in lower animals, is filled with cancellous bone.

GIBBON or long-armed Ape (Hylobates).

The gibbon's nose is less degenerated than the nose of many other apes. The maxillary turbinal has a double coil (Plate V, Figures A, B and C, 1). There are two well-defined ethmoidal turbinals (Plate V, Figures A, B and C, 2 and 3), and three small ethmoidal cells. The maxillary sinus is comparatively large and communicates with the nasal fossa through a small ostium, high up in the middle meatus (Plate V, Figures B and C, 10). The sphenoidal sinus is very large and opens into the superior meatus through a small ostium (Plate V, Figure A, 6). There are no ethmoidal turbinals in the maxillary or sphenoidal sinuses. The frontal sinuses are absent and in their place there is cancellous bone.

In apes, as a class, all the turbinals have degenerated and show a comparatively simple structure. The accessory sinuses present numerous variations. The maxillary sinus is always present and usually has smooth walls and a small ostium opening into the middle meatus. In some of the lower orders of monkeys, the ostium remains quite large and a small branch of the ethmoidal turbinal projects into the sinus.

The frontal sinus is present in the chimpanzee. In other apes it is absent and the frontal bone is cancellous.

The ethmoidal cells vary greatly in size and number. In some apes, there are none and the ethmoidal turbinals are very rudimentary. In others, there are several ethmoidal cells and the ethmoidal turbinals are not so much degenerated as they are in the apes, which have no ethmoidal cells. The variations in the sphenoidal sinuses are similar to those in the ethmoidal cells. In those apes in which these sinuses are absent, the ethmoidal turbinals are more degenerated and the ethmoidal cells are also absent.

MAN.

The general characteristics of the accessory cavities of the nose in man are well known. They present numerous variations, many of which are reversions to more primitive types. The absence of one or both frontal sinuses corresponds to the absence of these sinuses in most apes. The ethmoidal sinuses are cells surrounded by some of the numerous branches of the ethmoidal and adjacent bones and occasionally contain small ethmoidal turbinal scrolls, as they always do in such animals as the wolf. The subdivision of one or both sphenoidal sinuses into two or more cavities corresponds to a similar division of these sinuses in some of the lower animals in which the ethmoidal turbinals extend into the sphenoidal sinuses and produce numerous subdivisions. The irregular ridges sometimes seen on the lateral walls of the maxillary sinuses are probably rudiments of the ethmoidal turbinals which extend directly into the sinuses in some animals, and in certain species are attached to the sinus walls.

The accessory sinuses in the lower animals are developed, therefore, in conection with the olfactory portion of the nose. They are rather simple channels which conduct some of the inspired air over the external lateral surfaces of the olfactory turbinals.

In animals which have an acute sense of smell, the olfactory (ethmoidal) turbinals exhibit a tremendously intricate development and the accessory sinuses are correspondingly more highly developed, and all of them contain olfactory turbinal tissue. Their function is to conduct the inspired air more directly over a large surface of the olfactory turbinals, which would not otherwise be exposed to the air except by diffusion, and thus the accessory sinues increase the acuteness of the sense of smell.

In those animals in which the sense of smell is not acute, the olfactory turbinals have degenerated and receded from the accessory cavities. The cavities are left with comparatively smooth walls, their openings into the nasal fossae contract and their functional activity is lost.

In man the accessory cavities are almost completely shut off from the nose, their functional activity ceases, and they remain as rudimentary structures.

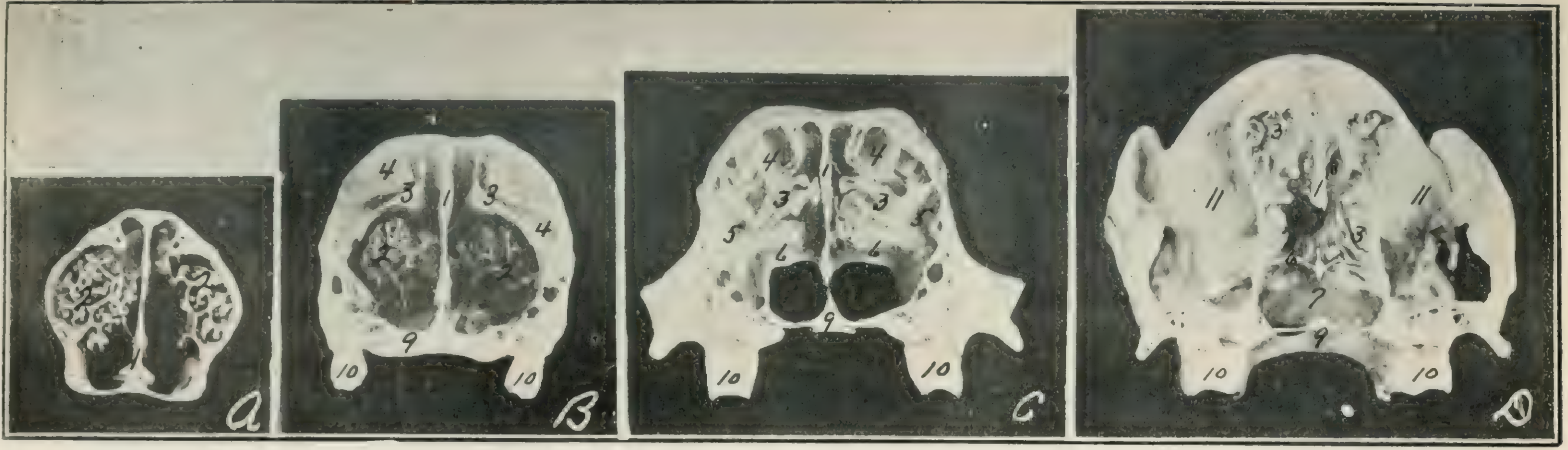

PLATE I KANGAROO (Macropus).

Transverse sections through a kangaroo's skull, showing both nasal fossae. A and B, looking anteriorly; C and D, looking posteriorly.

1. Nasal septum.
2. Maxillary turbinals.
4. Ethmoidal sinuses.
5. Maxillary sinuses.
6. Lateral wings of vomer.
7. Respiratory tract in the posterior inferior part of the nose.
8. Cribriform plate of the ethmoidal bone.
9. Palate.
10. Teeth.
11. Orbit.

PLATE II DEER (Cervus).

A. the left nasal fossa of a deer. B to G, transverse sections through both nasal fossae of a deer. B, D, E, F and G, looking posteriorly. C, looking anteriorly.

1. Maxillary turbinals.
2. Ethmoidal turbinals.
3. Brain cavity.
4. Posterior nares.
5. Septum.
6. Maxillary sinus.
7. Ethmoidal cells.
8. Palate.
9. Teeth.
10. Orbit.
11. Lateral wings of vomer.

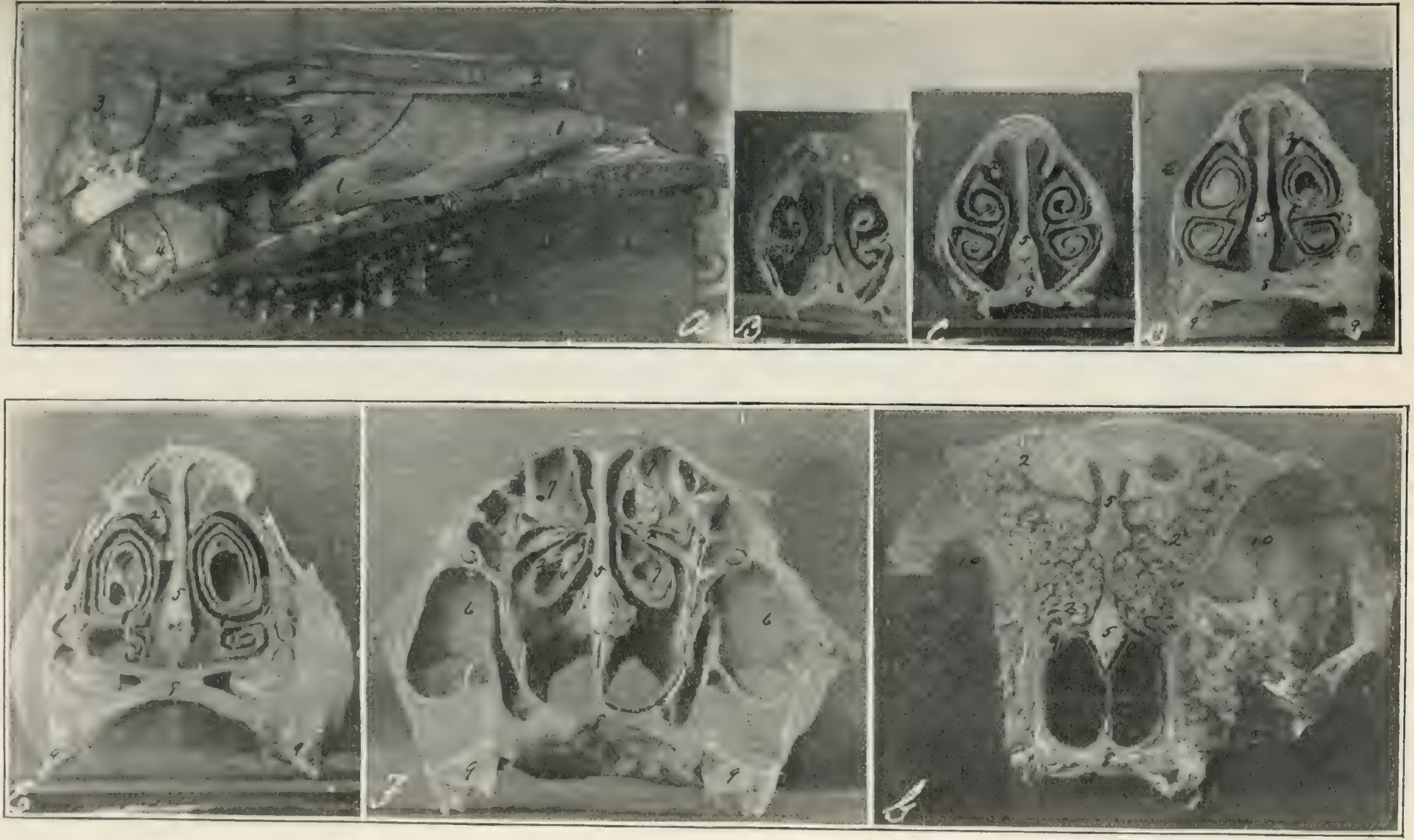

PLATE II

PLATE III. PRAIRIE WOLF (*Canis latrans*).

A, longitudinal section through a wolf's skull, showing the right nasal fossa. B, C and D, transverse sections through a wolf's skull showing both nasal fossae. B and C, looking anteriorly; D, looking posteriorly. (In Fig. B, the nasal septum is absent, having been lost in maceration.)

1. Maxillary turbinal.
2. Ethmoidal turbinal.
3. Ostium maxillare.
4. Ethmoidal turbinal in ethmoidal cells.
5. Ethmoidal turbinal in frontal sinus.
6. Frontal sinus exposed by removing its internal wall.
7. Cribriform plate.
8. Ethmoidal turbinal in sphenoidal sinus.
9. Brain cavity.
10. Posterior nares.
11. Maxillary sinus.
12. Ethmoidal turbinal extending into the maxillary sinus.
13. Orbit.
14. Palate.
15. Teeth.
16. Vomer.
17. Lateral wings of vomer.
18. Septum.
19. Respiratory tract in the posterior inferior part of the nares.

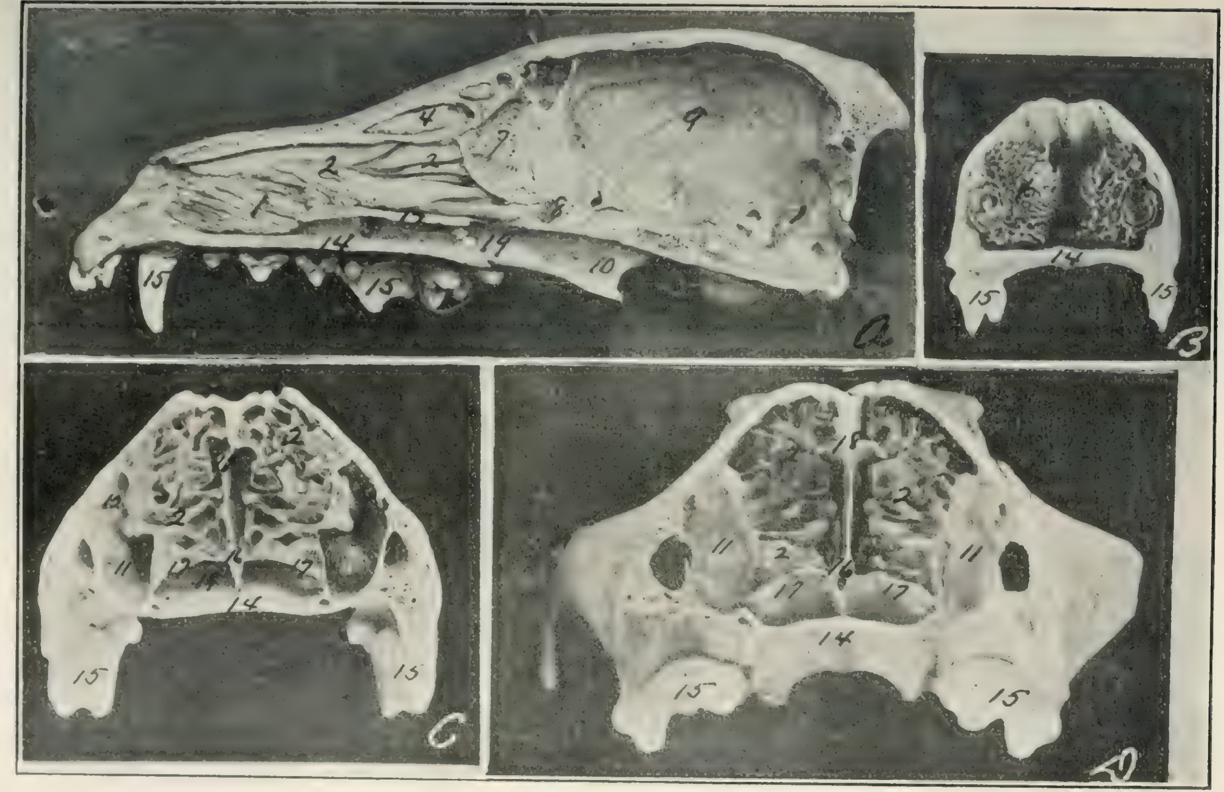
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PLATE III.

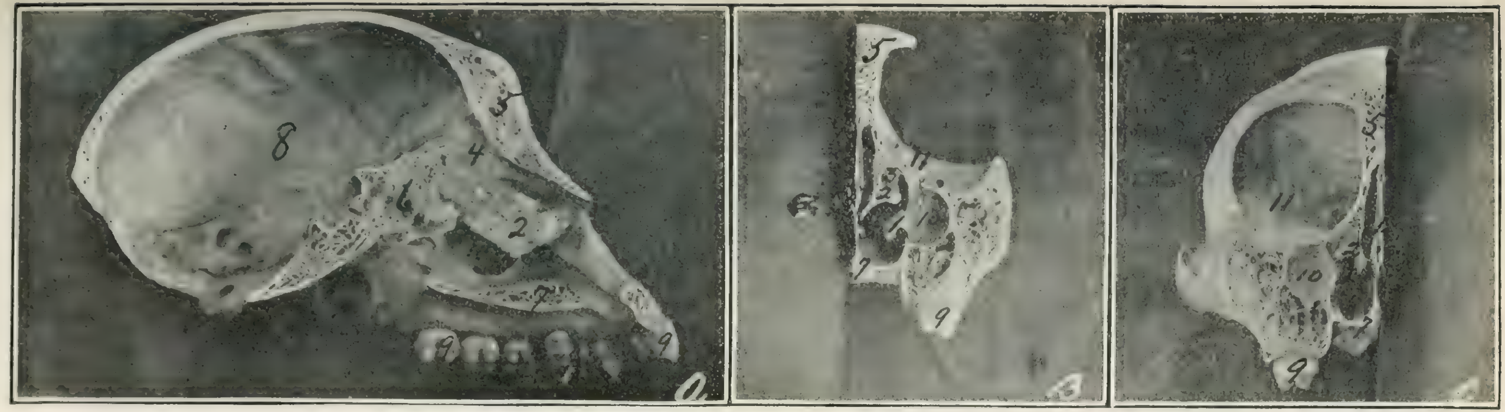

PLATE IV. INDIAN APE (Macacus rhesus).

A, longitudinal section through ape's skull, showing the left nasal fossa. B and C, transverse section through the right nasal fossa of an ape. B, looking anteriorly; C, looking posteriorly.

1. Maxillary (inferior) turbinal.
2. Ethmoidal (middle) turbinal.
3. Ethmoidal (superior) turbinal.
4. Cribiform plate of ethmoidal bone.
5. Cancellous frontal bone.
6. Cancellous sphenoidal bone.
7. Palate.
8. Brain cavity.
9. Teeth.
10. Maxillary sinus.
11. Orbit.
12. Nasal septum.

In Fig. A, the maxillary turbinal has been lost in maceration and the maxillary sinus (10) is exposed.

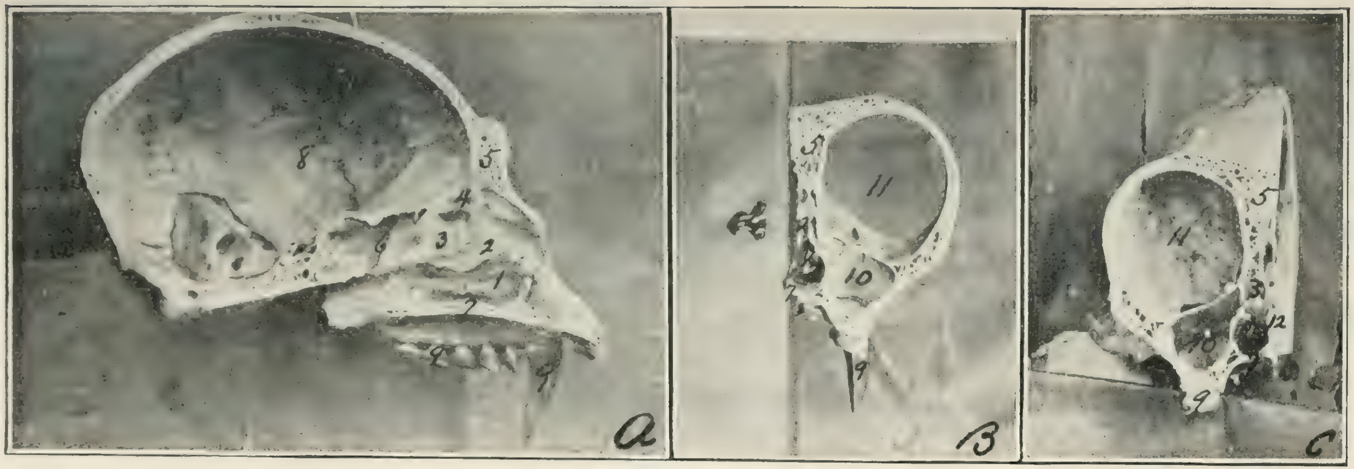

PLATE V. GIBBON (Hylobates.)

A, longitudinal section through a gibbon's skull, showing the left nasal fossa. B and C, transverse sections through the right nasal fossa of a gibbon. B, looking anteriorly; C, looking posteriorly.

1. Maxillary (inferior) turbinal.
2. Ethmoidal (middle) turbinal.
3. Ethmoidal (superior) turbinal.
4. Cribriform plate of ethmoidal bone.
5. Cancellous frontal bone.
6. Large sphenoidal sinus.
7. Palate.
8. Brain cavity.
9. Teeth.
10. Maxillary sinus.
11. Orbit.
12. Nasal septum.

LIV.

GENERAL PATHOLOGIC PROCESSES ASSOCIATED WITH OR FOLLOWING INFECTIONS OF THE ACCESSORY SINUSES.*

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PHILADELPHIA.

Pathologic alterations of the structures of the accessory sinuses may be divided into two classes, according to the tissues involved: First, we have the changes affecting the mucous membrane alone, and, second, those involving the deeper structures or bony framework.

The accessory sinuses are, for all practical purposes, closed cavities, and while the mucous membrane lining these cavities is similar to that of the upper respiratory tract, yet the glandular elements and the terminal nerve filaments are not nearly so numerous as in the exposed mucous membrane. The epithelial layer of the membrane is also much thinner and the cells resemble more those of the endothelial type, and the mucous membrane, therefore, has less resisting power.

Inflammatory processes involving this structure do not differ from those occurring in any other mucous membrane, with the exception that they pass through the various stages with greater rapidity, so that the difference is merely one of degree or intensity. Any infection of the accessory cavities would necessarily be preceded by or associated with some inflammatory process, which process involves the opening of the sinus and thus converts it into a closed cavity, causing retention of the infectious material. This in turn intensifies the already existing inflammation and produces rapid changes in the mucous membrane, which, if drainage is not established, may lead to total destruction of the membrane and necrosis of the underlying bony structure. If the severity of the inflammatory process is not sufficient to cause destruction of the mucous membrane and denudation of the bony walls of the cavity, a fibroid formation within the basement membrane may take place, or in other words, the physiologic function is interfered with, resulting in permanent pathologic alteration.

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*Read at the Meeting of the American Laryngological, Rhinological and Otological Society, Kansas City, June, 1906.

When there has been a destruction of the mucous membrane lining these cavities, it is not likely to be regenerated, owing to the fact that the blood supply to the submucosa is not so profuse as in the respiratory tract, and also that the genetic layer of the epithelial surface is less substantial and less capable of reproduction.

I have observed in a few cases, where the accessory cavities had been freely opened, that the pathologic alteration accompanying the process had not produced a permanent lesion, and when the cause was removed the mucous membrane returned to the normal, but the practically closed cavity had been converted into a wide-open one and the patient suffered from symptoms almost identical with those of confined suppuration of these cavities, such as faceache, the neuralgia, sense of pressure, the general discomfort with, of course, no rise in temperature. One of these cases in particular, I have watched for the past three years. This individual had six accessory cavities opened and the delicate, sensitive mucous membrane, which was not physiologically intended to come in contact with the air and dust, was particularly susceptible to the slightest climatic changes. It was found by placing the patient in a room with an even temperature, that almost instant relief was obtained, and I believe that all the symptoms were produced by the use or misuse of these sinuses, as they are not intended as respiratory cavities. By stimulation following the use of these cavities, and the increase in the blood supply of the exposed mucous membrane as a result of this stimulation, the membrane has gradually thickened and, in other words, has physiologically changed, and while it may be somewhat of a pathologic process, it has produced a physiologic result and lessened the sensitiveness of these cavities and developed the membrane. During the past winter the patient has had practically no symptoms of any involvement of these sinuses.

As a rule, confined suppuration within the accessory cavities show irregular systemic symptoms, unless there is a point where the physiologic wall of the closed cavity has broken down, and rapid general septic infection takes place, when the clinical phenomena are pronounced. In other words, infection of the accessory cavities amounts to a walled-in process, and it is only when necrosis takes place that systemic infection occurs.

Infection of the accessory cavities is usually secondary to or associated with lesions of the adjacent structures, and in a large majority of cases, the etiologic factor may be found in the nasal cavity. The continuation of the pathologic process within the accessory cavity will depend entirely upon the pre-existing condition within the nasal cavity. While the pathologic alteration occurring within the cavity is a definite and distinct one, the arrest of that process is subject to the same general law which is the basis of all surgical treatment, namely, the removal of the cause. If the infection is due to the pneumococcus, streptococcus or bacillus of influenza, there is a marked tendency to bony necrosis.

A point of considerable importance, as regards the invasion of surrounding structures by the pathologic process, as well as accounting for the varied symptoms produced, is the size and shape of the cavity and the variations in the thickness of its walls. For example, a frontal sinus with thin walls may result in perforation and involvement of the brain cavity. Dural and subdural abscesses frequently follow pathologic changes within the frontal sinus. Again, in the case of the antrum of Highmore, where the superior wall is very thin, you will have marked eye symptoms, while in another case with a thick bony wall, the eye symptoms will be entirely absent. The spreading of an infectious process from one accessory cavity to another is usually explained by some abnormal communication.

Irregularities and abnormalities as to the formation of the accessory cavities, the antrum, etc., may explain many of the peculiar and unique cases often reported. It has been shown by sections of the skull, with a view to demonstration of the relation of the accessory cavities to the nasal chamber, that almost any size or shape of cavity or thickness of bone is possible, the antrum cavities varying in size from a little larger than a pea to three times the usual size and extending under the floor of the nose.

In cases associated with nasal lesions, it is quite likely that the chronic inflammatory process set up in the floor of the nose may interfere with the nervous and vascular supply of the tooth directly under it, causing a trophic function with devitalization.

Recent clinical observations have clearly proven that many lesions of the head and face suggesting antral disease, the cause of which has been more or less obscure, have their origin in abnormal or pathologic conditions of the dental organs, such as teeth irrupted into the nose or antrum, or diseased teeth affecting either cavity.

Irregularities in the formation of the accessory cavities will bring about irregularity in the upper arch and predispose to dental lesions as well as nasal disease. This is not only caused by nasal obstruction and improper passage of air, but also by poor nutrition, as the current of air passing to and fro in the nostril stimulates circulation in the nasal mucous membrane. One-half of the arc of the orbit is taken up by the accessory cavities and many eye symptoms are associated with or follow lesions of these cavities. Orbital abscess is secondary to disease of the sinuses, displacement of the globe may be occasioned by encroachment on the orbit by a distended sinus, and blindness may result from an involvement of the chiasm through the roof of the cavity or by an implication of the optic nerve as it passes through its foramen in the sphenoid, as a consequence of inflammation in the cells within that bone. A general orbital cellulitis may be occasioned by an acute perforation of any sinus. Edema of the lids is one of the most significant symptoms of disease of the accessory sinuses and is to be distinguished from the inflammatory swelling and thickness of the lid which results from cellulitis, as it is entirely non-inflammatory in origin. Paresis, and even paralysis, of one or more of the eye muscles may occur as a consequence of sinusitis.

The sphenoid and ethmoid cavities, being in reality nothing more than honeycomb cells, an infectious pathologic process occurring within these cavities is extremely likely to produce bony necrosis, if the infectious process is of sufficient severity to cause necrosis of the mucous membrane.

The delicate bony structure is dependent upon its blood supply coming from the mucous membrane; this is not true of the frontal sinus and antral cavity. In the latter cavities the bone may be denuded of mucous membrane with no necrosis of the bony structure. In other words, bony necrosis is more likely to occur within the ethmoid and sphenoid cavities. The pathologic changes in the sphenoid and ethmoid cavities, following infections, even after the cavities are opened, is more likely to continue than in the frontal or antral cavity. In the latter, better drainage can be established, and the infectious material can be more thoroughly eradicated; in other words, more complete surgical interference can be employed in the antral and frontal cavities than in the sphenoidal and ethmoidal.

Meningitis and sinus involvement is likely to follow frontal, ethmoidal and sphenoidal sinusitis. Occasionally, cases are seen in which infections of these cavities produce practically no symptoms.

I recall a case which came under my observation in 1899 and which I reported at that time. The patient, a woman of sixty years, after being indisposed for a few days, experienced a sensation of fullness on the left side of the nose, opposite the inner angle of the orbit. There was no pain, only a sense of uncomfortable fullness. There was a considerable discharge from the nose of a thin, watery secretion; the character of the secretion varied slightly in the morning, when it was thick and tenacious. There was a great deal of swelling over the face, especially between the eyes, which gave a peculiar facial expression, as though the eyes were wide set. There was not much tenderness on pressure over the swollen area. There was, however, some soreness at the inner angle of the eye over the region of the ethmoid cells. During the month of February, the symptoms first being noticed in January, the patient had quite a severe attack of epidemic influenza or la grippe. She was confined to her house about a month. During this attack there was practically no change in the condition of the forehead. The swelling remained about the same, and there was possibly a slight increase in the clinical phenomena. However, after the patient was able to be up, which was about the first of April, the swelling became more marked, especially under the eyes and on the left side in the region of the nasion, about an inch and a half above the base of the nose. There was considerable discharge from the nostril, possibly more pus-like, although nothing more than would be from an ordinary continued rhinitis. There was more soreness at this time, although not painful; the patient complained of malaise and a peculiar sick feeling; there was marked general debility, and the patient seemed to be failing very fast in general health. Prior to this attack she had been in the best of health—had never up to that time even suffered from a headache. During the month of May the patient developed marked swelling in the limbs—in fact, all the symptoms were aggravated; there were sore spots here and there over the limbs, with some petechiae and slight inflammation. There was constant shifting of these spots. There were pronounced aching about the joints and symptoms of a decided rheumatic condition or gouty diathesis. There was very little change in the swelling of the face; if any difference, it was more marked. At no time was there any acute pain, the prominent symptom being the edematous condition. The patient had lost over thirty pounds in flesh, and was quite weak and debilitated. The last of June she consulted me, when I found the following conditions present:

The tissue on the forehead was so swollen that it hung down over both supraorbital ridges, with marked swelling under both eyes, especially the left, giving the patient's face a most peculiar appearance. In the median line, about an inch above the line of the supraorbital ridge, was a marked projection, almost tumor-like, with distinct redness, and somewhat pitted in the center, with a small spot on which there was some dried secretion. On examination of the nose I found practically no discharge on the right side, only a slightly catarrhal inflammation; the left side was markedly edematous; the mucous membrane was covered with a thin glairy discharge with tendency to accumulation. The upper part of the nostril was so edematous and swollen as to completely occlude the cavity. This tissue was depleted by the local use of an 8 per cent solution of cocain, and after retraction of the tissue I could elicit no discharge from the openings of any of the accessory cavities. After the use of the cocain, there was perfect breathing through the nostril. There was practically no pathologic alteration within the nasal structure, the septum being almost straight, and there was enlargement of the turbinal bodies or lining membrane. Transillumination was resorted to, from a diagnostic standpoint, and the antra showed a perfectly clear outline. I was unable to make any satisfactory illumination of the frontal sinus or of the upper portion of the nose; however, I believed I had to deal with a confined suppuration in the left frontal sinus, or possibly involving both sinuses. In passing a probe over the skin at the point bulging with pitting, on removal of the slight crust formation I found that the necrotic tissue had given way and the abscess was already opened externally. On pressure, and by the patient leaning forward, there was a discharge of foul-smelling thick pus, and by slight digital examination I found that there was a necrotic area, almost circular, about three-fourths of an inch in diameter. I then passed a probe into the opening, and, allowing it to follow the line of least resistance, it passed down without any force whatever, until it lodged against a soft material. By tapping it gently I felt that it was necrotic bone. With a little pressure the probe passed through into the nasal cavity. At the same time light was reflected into the nostril, and the point of the probe could be seen on the septum side of the middle turbinate, about the middle third. I then had free drainage. After the discharge of pus the sense of fullness at the inner angle of the orbit, which had continued from the first, entirely disappeared. The cavity was flushed out with warm boric acid solution, followed by hydrogen peroxid, cinammon water and aqueous extract of hamamelis, equal parts. Within forty-eight hours the swelling had entirely disappeared from the face. The time from the spontaneous opening of the abscess until the complete closure of the wound was about two months. Occasionally, the external opening would become occluded with dried secretion with slight return of the facial swelling; on reestablishment of drainage this quickly disappeared. The patient's general health was improved by internal medication. Urinary examination showed no structural lesion of the kidney, but some leakage of serum albumin, possibly from the relaxed blood vessels.

From a general pathologic standpoint, we should remember that the accessory cavities are truly such and that they are not independent cavities; that they are accessory cavities to what? to the nasal respiratory tract. Hence, the origin of many pathologic lesions is the nasal cavity. We must remember, also, that these accessory cavities are dependent upon adjacent structures for nutrition. Also, when infected, you are dealing with a closed cavity, but not a cavity of new formation, hence the pathologic alteration is not subject to the same law as that of a cavity of new formation.

LV.

GASTROSCOPY.

By Chevalier Jackson, M. D.,

PITTSBURG, PA.

The treatment, medical and surgical, of gastric diseases is not, and should not be, within the province of the laryngologist. Yet, judging from results that I have obtained, direct inspection of the stomach is not difficult to one skilled at esophagoscopy, as every laryngologist is or should be, provided he has a proper instrument.

No practical instrument of this kind for passage through the esophagus has ever been produced heretofore, but with the gastroscope herewith illustrated, inspection of certain portions of the stomach is easier than bronchoscopy per vias naturales.

Until the procedure shall have been extensively taught in post-graduate schools and opportunities thus afforded for experience, the work will have to be done by the rhino-laryngologist. Long trained in the examination of deep-seated mucous membranes by artificial illumination, he can see at a glance varying conditions of the mucosa that would not be evident to another. He is accustomed to relax the accommodation of one eye and to ignore its image, while looking at deep mucosæ with the other. Furthermore, his familiarity with esophageal instrumentation renders him facile at passing the instrument and especially at the starting of it.

Having aided the physician and surgeon in the diagnosis, the laryngologist's active concern in the case should cease; the day will come when the gastrologist and the general physician and surgeon will pass the gastroscope as frequently as the gynecologist now passes the cystoscope.

Usefulness. Gastroscopy is not simply a feat. It has a field of usefulness that will increase as our skill and knowledge increase.

With the gastroscope I have made a diagnosis of gastritis in one case, of gastroptosis in one case, of malignant disease of the pylorus in one case, malignant disease of the cardia in one case, peptic ulcer in three cases, one of which was cured by direct applications. I have removed one foreign body from the stomach.

The diagnosis of the malignant cases was not made early, because the cases were brought to me late in the disease. When the gastroscope shall have reached its deserved recognition, these cases will be examined sufficiently early to give the abdominal surgeon a fair chance. Better still, a positive diagnosis of pre-cancerous conditions will be made sufficiently early to enable him to save lives that are now lost through reluctance of the patient to submit to an exploratory operation. I do not intend to advocate gastroscopy as a substitute for exploratory gastrotomy. There are, however, many patients who refuse to be explored surgically. If a patient is told that he has a cancer, usually he is willing to submit to an operation, which is often too late to help him. If we tell him a cancer or a pre-cancerous condition is suspected, and we wish to explore and see, only too often he declines in this early hopeful stage. But the proposal to insert a tube through the mouth for examination will be rarely refused. This I feel sure will enable in many instances needful early diagnosis. The vital importance of early diagnosis in malignant and pre-cancerous disease of the stomach renders every possible aid of greatest value. When the diagnosis is made from a palpable tumor, cachexia and the vomitus, it is useless, usually, except for prognosis.

In considering the possibilities of gastroscopy, the occurrence of tumors other than carcinomata and sarcomata must not be forgotten. The gastroscope renders it possible to take a specimen in cases of fibromata, myomata, lymphadenomata, etc. Of these, however, I can offer no reports of cases.

One of the limitations of gastroscopy at present is the limited value to be placed upon negative results. Any lesion, if it exist in the explorable area, can be seen and, if advisable, felt, with the probe, and its nature determined; but if no lesion be found, we cannot be certain that none exists in the unexplorable area. However, with greater skill I feel sure this unexplorable area will be diminished.

Instruments. The great difficulty to be overcome in the direct inspection of the stomach through the esophagus has been the loss of light on account of the length of the tube required. This has been overcome, as in my bronchoscopes and esophagoscopes, by placing the lamp at the distal extremity of the tube where the light is needed. This not only prevents loss of light on account of the distance, but the even greater loss from a few drops of secretion or of a probe or forceps or any other substance in the tube, such substance cutting off so much of any light projected into the tube that nothing could be seen satisfactorily. With the light at the distal end the gastric mucosa is as clearly shown to view, at the end of the 80 c.m. tube, as is the laryngeal mucosa in the laryngoscope.

The diameter of the adult gastroscope is 9 m.m. and the length is 80 c.m. (Fig. 19). The general form of the tube and obturator is the same as the esophagoscopes and bronchoscopes that I devised some years ago. The distal end of the instrument is a thickened ring to prevent injury to the tissues. My attention has been called to the fact that through defective workmanship some of the bronchoscopes on the market, to which my name is attached, were made with a sharp angle at the ring, which made it difficult to avoid wounding the mucosa.

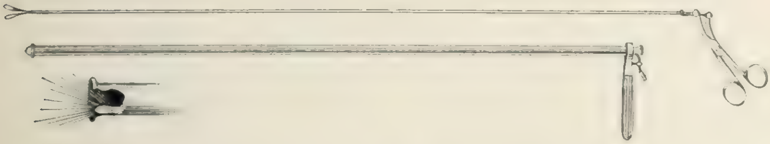


Fig. 19

The gastroscope is fitted with an obturator or pilot which presents a conical tip beyond the tubal orifice, the conical end facilitating the introduction of the instrument into the introitus esophagi superioris, especially for those unfamiliar with the work. No graduations are marked upon the exterior of the tubes. They are not necessary and the roughness is a disadvantage. It is easy to measure with a sterile steel centimetre rule the distance between the upper teeth and the outer end of the tube. Thus 80—7=73 centimetres below the upper teeth.

The light is carried on a removable light-carrier which passes through a small auxiliary tube made in the wall of the main tube. The small lamp, when the carrier is in place, is right at the distal end of the gastroscope where it brilliantly illuminates the field, while it is itself out of the way of vision and instrumentation. The light-carrier is attached to the cord with a bayonet fitting which can be used to turn on and off the current. The cord is covered with rubber, permitting alcoholic sterilization.

Commercial lighting circuits should never be used for lighting the lamps. All rheostats have one live side which may be "grounded" through the patient, involving great danger, even if of no more than 110 volts pressure, on account of the good contact with the moist mucosa, throughout the length of the tube. Dry batteries involve no risk whatever and with intelligent care are perfectly satisfactory.

In addition to the gastroscope the essentials are: A secretion aspirator, cotton carriers, tube forceps, probe, extra lamps, a mouth gag, a glass of sterile vaseline, sterile cotton and sterile gauze strips, about 1x6 c.m. in size for use in the carriers.

The forceps are lengthened forms of the forceps devised by me some years ago for bronchoscopic work. They have the advantage that in working the tube is pushed over the jaws, the jaws are not pulled into the tube. Thus the jaws do not retreat from their bite and the strength of grip is really astonishing.

Anesthesia. Cocain anesthesia in a courageous patient is sufficient so far as the pain of examination is concerned, but it does not stop the retching like deep general anesthesia. Chloroform I consider dangerous for esophagoscopic, and especially for gastroscopic, though not for bronchoscopic work. Deep anesthesia is absolutely necessary to prevent retching, which is to be avoided while the tube is in the stomach, and prolonged deep anesthesia is not safely maintainable with chloroform. Ether, then, is the choice, preferably started with nitrous oxide.

Technic. There are two essentials that I desire to emphasize at the outset. These two things are so commonly (I had almost said criminally) ignored that I cannot make the emphasis too strong. The first essential is asepsis. Of course absolute ideal asepsis is impossible, because the field cannot be sterilized, but oral antisepsis will help. The teeth should be put in good order by a dentist; they should be cleaned with a brush and thymol-menthol solution, followed by a carbolized mouth wash. The stomach is better not washed out except by the inpouring of its own secretions during the fasting period. The face and neck should be washed with soap and water, followed with bichlorid rinsing. The hair should be covered with a sterile rubber cap. The instruments should be absolutely sterile. All the instruments can be boiled except the lamps and light carriers. These can be immersed in alcohol. The other essential is gentleness. Absolutely no force is to used. The utmost gentleness must be observed, lest abrasions of the esophagus be produced. Skill, not force, is required. Some operators who have used my esophagoscopes and bronchoscopes have asked why I did not have them made heavier and stiffer, with larger, stronger handles, etc. All this implies rougher handling than is necessary or justifiable. The two first fingers of the right hand are all that are necessary, assisted by the thumb, which holds the obturator in position (Fig. 18) and gently pushes the instrument inward when

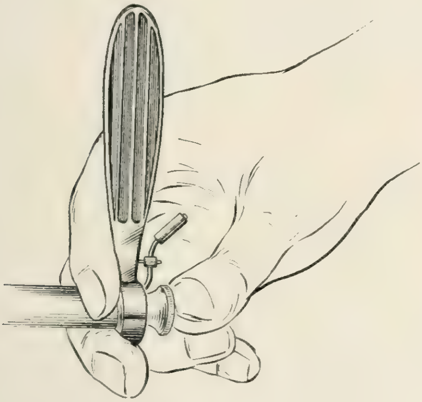


Fig. 18

the finger of the left hand has raised the cricoid cartilage and larynx upward (supine patient) away from the vertebra, thus opening the introitus esophagi superioris (Fig. 17). The end of the tube is guided along the finger, being careful not to gouge the posterior pharyngeal wall, which is rigid by reason of its being backed by the vertebræ. If the cricoid cannot be reached, lifting the epiglottis and tongue will serve.

A number of times I have seen men grasp the handle of the instrument like an L-shaped umbrella handle, ramming it down, and prying around in various directions, failing to enter the esophagus and gouging out long sections of mucosa from the posterior pharyngeal wall. Again I have seen the sinus pyriformis and the arytenoids rammed so that they ached for days. All this is wrong, and, to repeat, skill, not force, is required. If the esophagoscope is placed rightly, a gentle push with the thumb will cause it to enter the esophagus, when, if it has been well greased, it will slide down with the most gentle touch. A good set of upper teeth is somewhat in the way, but there is plenty of room at the side of the mouth, the head being inclined slightly toward the opposite (left) side if necessary. The head should hang over the table in Rosen's position, the patient being supine, and the operator standing at the head of the table looking toward the patient's feet. The table should be rather high, so that a slight incline, made by elevating the foot of the table, will not make the head too

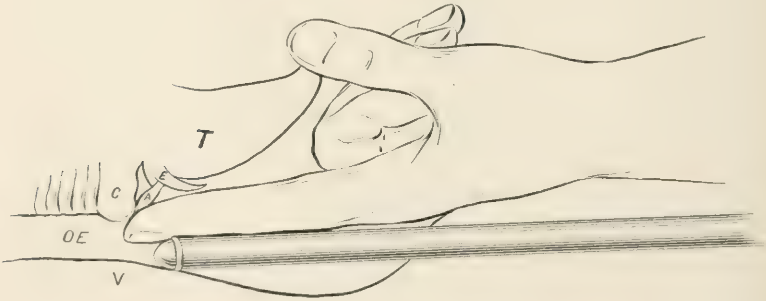


Fig. 17 (Diagrammatic).

low for comfortable work. This inclination favors the flow of secretions outward. The reverse position is useful.

Three points of obstruction may be noticed in the normal esophagus in some instances:

(1) At the entrance, behind the cricoid cartilage; (2) posterior to the bifurcation of the trachea, and (3) at the hiatus diaphragmatis. Occasionally an obstruction is met with at the cardia, not so much from constriction as because of the deviation of the esophagus to the left.

These all vary greatly in different individuals and may not be noticed at all. At the bifurcation of the trachea the impulse of the aorta is marked. At the diaphragm often there seems more of an obstruction than there really is, being accentuated by the curve of the esophagus at this point which allows the esophagus to come against the margin of the diaphragmatic hiatus. After the extremity of the gastroscope passes the introitus esophagi superioris, it is better to remove the obturator, and attach the cord by the bayonet fitting to the light-carrier, as the tube can be guided more gently by the eye which enables the following of the opening up of the tube ahead, especially when obstructions are met.

After the stomach is reached there are two plans of exploration, both of which should be carried out. First the gastroscope should be passed down carefully and gently to the greater curvature, inspecting the anterior and posterior walls. At times these walls do not seem to be fully collapsed ahead of the tube and one will have to be examined first, then the other. Then the tube is withdrawn, inclined slightly laterally in the same plane, then pushed gently downward again in a new series of folds.

After the whole possible range has been covered in this way, we proceed to the second plan. The tube is passed down until the extremity touches the wall of the greater curvature in the extreme left of the possible field. Then the tube is moved slowly along the greater curvature, but not in too close contact therewith, until the extreme right is reached. Withdrawing the tube a centimetre or two, the field is slowly swept again in the same plane, but at a higher level, and so on upward to the cardia. Next the deft fingers of one skilled in abdominal palpation is called upon to manipulate the unexplored portions over in front of the tube. This is sometimes better accomplished by turning the patient on his side, first on one, then on the other. During all these manipulations the tube must be withdrawn within the esophagus. When the stomach is in its new position the gastroscope is again pushed downward and the newly available surfaces are explored. Should retching supervene while the gastroscope is in the esophagus, no harm will result, but when the tube is in the stomach, retching is the signal for immediate withdrawal of the gastroscope until the distal end of the tube is above the diaphragm. The instrument should be greased with a gauze sponge dipped in vaseline. Gauze strips are best for cleaning the lumen of the tube when withdrawn.

Difficulties. So far as the passage of the instrument into the stomach is concerned, there is no difficulty to one accustomed to work in the throat, and to whose fingers every landmark is familiar. To one unaccustomed to work in this region, some difficulty may be experienced at first in entering the tube, even with its obturator, into the introitus esophagi superioris. A flow of fluid out through the tube causes delay rather than difficulty. The stomach seems never to be completely empty. There is always a pocket or fold to be found out of which some fluid will pour. This, if normal, readily flows away. Thick, viscid secretions, as in gastritis, may cause delay. It might seem easy to pump away all fluid, and if the stomach wall were like a hot water bag, this would be easily done. But in the nearly empty stomach there are wrinkles, folds, and pockets, only one or two of which can be emptied at a time. A diverticulum in one case was a source of some difficulty, its orifice being so much larger than that of the esophageal lumen below. Careful inspection and the wiping away of secretion with the gauze mop enabled the finding of the esophageal lumen below and the insertion of the gastroscope therein. It would have been impossible to have passed a bougie in the old way beyond this diverticulum. Cardiospasm in one case was a difficulty that was overcome by the use of the well-oiled obturator guided intelligently by the foreknowledge of direction gained by the previous inspection. Cardiospasm is prevented by profound general anesthesia, but this was not considered wise in the case mentioned.

Inaccessibility of some portions of the stomach, of greater degree in some patients than in others, and of greater degree at some times than at others in the same patient, offers difficulties. These may be overcome by the skilful but very gentle manipulation of the tube combined with skilful and gentle manipulation of the tumor or stomach on the abdominal wall externally. The movability of the mass in some cases of gastric cancer, especially in thin people, may permit a skilful manipulator to bring what seems a very remote mass right before the gastroscope. Sometimes the pylorus can be more closely approached by turning the patient on the left side, at other times turning has seemed to cause the pylorus to move away. The exploration of the fundus in the adult is an impossibility with any instrument I have been able to devise, though a good manipulator with hands on the abdominal wall externally may assist the operator and with a very relaxed abdominal wall or infantile form of stomach, much of the fundus can be brought into view. The radiograph (Fig. 20) by Dr. R. H. Boggs, shows the range of motion of the tube without abdominal manipulation in a case of gastroptosis. The patient took ether badly and was not fully relaxed. The rigidity of the diaphragm seemed to interfere with the movement of the tube. In flaccid elderly persons of spare build, more than twice this range of motion is easily obtained. The head and neck should be swayed sideways with the tube in the esophagus, which will cause the distal extremity of the tube to move in the opposite direction. The indistinct outline is due to the radiograph being taken during ether anesthesia. Bismuth given the patient failed to show. The range of mobility of the normal stomach is astonishing. The lower portion of many normal stomachs can be pushed into the pelvis.

The greater curvature for an extent of about 14 c. m. is readily explored. The portion, if any, of the lesser curvature which happens to be nearly vertical may be explored readily. A considerable area of both the anterior and posterior walls is readily examined without the aid of the hand of an assistant externally upon the abdomen.

Dangers and Contra-indications. In a patient with a normal esophagus and stomach the only dangers are those of general anesthesia. If cocain be used there is no danger. In esophageal ulceration, care should be taken and if deeply eroded the gastroscope should not be allowed to pass lest the thin bed of the ulcer be broken through, not by the instrument but by a possible retching. Doubtless if so thin as this, the ulcer would soon perforate anyway.

To bite out the edge of the ulcer is easy with the tube forceps shown in Fig. 19, which I have designed for tube work. It seems to me that the risk of perforation in non-malignant conditions is great. In evidently malignant cases, where the infiltration is a protection, and especially in fungatng cases, the risk I am sure is slight. Aneurism, if present, constitutes a danger that is almost prohibitive. Grave heart lesions are a contra-indication, though the lessor or the well compensated lesions are not prohibitive, unless they be unsafe subjects for anesthesia. The same may be said of other organic diseases.

The manipulations externally, so valuable in bringing various portions of the stomach in front of the tube for view, involve no risk whatever in a stomach whose walls are not weakened by disease. In the ordinary inflammatory conditions no weakness exists, nor in most cases of malignant disease. In ulcer, however, caution is necessary, though with due gentleness no ulcer floor will be perforated save that of one which must soon have perforated by erosion or by the normal spontaneous movements of the stomach, especially when containing food. Hemorrhage is a possibility only in diseased states of the stomach or esophagus. A normal vessel cannot be ruptured by the skilful and gentle use of the gastroscope. In the three cases of gastric ulcer and the two cases of gastric cancer diagnosticated gastroscopically, no hemorrhage followed. There was no bleeding in any of the normal cases. In cases with a history of recent hemorrhage, doubtless it would be wise not to pass the gastroscope until at least a month free from all signs of hemorrhage had elapsed. Diseases of the esophagus as malignant diseases and ulcer constitute no danger, as after passing the level of the cricoid cartilage, the obturator is removed and the instrument passed by sight, so that due caution may be observed when disease of the esophagus comes into view. Even without this it seems that skill should render it safe. Such an accident as the forcing of an instrument through the bottom of a diverticulum, as has happened with a rubber stomach tube (with stilet), can be readily avoided. An affectation of roughness and brutality are often mistaken for courage by the "bold surgeon." Gentleness and skill are needed and will avoid all dangers. Over-extension of the head, especially if the shoulders are dropped, endangers the patulousness of the tracheal lumen. Considering the prolonged (and for a time harmless) sojourn in the human stomach, of foreign bodies such as glass, open pocket knives, nails, tacks, etc., swallowed by the insane, the intoxicated, and others, it does not seem, theoretically, that any risk is incurred in passing a tube into the healthy stomach.

Gastroscopic appearances. Orientation is not easy on account of the great variation in the size, position and shape of the stomach. If the stomach in life were anything like the classic illustrations in the anatomic works, orientation would be easy. Landmarks are few. The passing of the cardia is determined usually with certainty by the change in color of the mucosa, and the encountering of the plicae mucosae. These folds extend away from the orifice of the gastroscope in long ridges which disappear in the depths beyond or diverge and blend into other ridges. As the lower portions of the stomach are penetrated, it is noted that these ridges have a trend rather transversely than directly away from the visual axis. This usually marks the approach to the greater curvature if the stomach is in classic position. Often, however, the transverse ridges are not encountered and the receding ridges are followed for what seems to be an incredible distance. This usually indicates that the stomach is in a more or less vertical position and in one such instance my instrument reached the pylorus.

In portions of the stomach only slight ridges or folds were seen (Fig. 7), and at times an approach to flatness (Fig. 8) was noted. Both of these were when the tube was pushed firmly against the stomach wall. In general, however, the appearance of the normal mucosa is fairly well represented in Figures 2 to 6 inclusive. The stomach mucosa is at times seen to move even when the tube is held stationary. In dangerously deep anesthesia this movement is absent. In many cases no movement could be detected unless retching was imminent.

As with examinations of mucous surfaces elsewhere, the appearance only is not reliable without the aid of the probe and the cotton applicator. For instance, in Figs. 9 and 10 what seemed like a pathologic mass capped by an ulcerated surface, when wiped and probed proved to be simply a normal fold, capped by a mass of secretion. This was a case of chronic gastritis. Figure 10 shows the appearance where all the ridges in sight except one were wiped clean. The secretions of a stomach which has fasted for 18 hours are a rather thin fluid with very little viscidity, and of a transparent brownish or olive tint. It runs out of the tube in a stream at times.

The normal healthy stomach after 18 hours' fasting usually does not contain mucus in any quantity. In my examinations I did not find any tenacious mucus in a normal stomach. The mucus swallowed from the upper digestive tract and bronchi is usually in isolated clots and not adherent, while in the one case of chronic gastritis examined, the tenacious mucus was in close contact with the stomachal mucosa and was not readily wiped away.

The gastroscopic appearances offer an enormous field for study, of which great good will come.

Case I. *Ulcer of the lesser curvature. Diagnosis and cure with the aid of the gastroscope.* Mr. M., aet. 32. Referred to me for gastroscopy by Dr. H. Finkelpearl. Patient complained of dull, uneasy sensations over the abdomen after eating, followed an hour later by pain in the epigastrium. Upon passing the gastroscope I found, after a fifteen minute search, an ulcer upon the lesser curvature about 3 centimetres below the esophageal margin. The ulcer was on the crest of a ridge and could not be manipulated so as to come flatly before the tube by the gentle maneuvers which I deemed advisable. The ulcer is represented in figure 11 as seen on edge. The figure should be given a quarter turn against the hands of the clock, as should also figure 12. The yellow in the plate is too strong.

I made an application of a ten per cent argentic nitrate solution which was repeated a week later. Upon re-examination the ulcer was found cleaner with reddish granulations scattered upon its surface. The case was then treated by Dr. Finkelpearl by swallowed remedies in the usual way, and three weeks later it was well symptomatically, and the ulcer had healed, leaving a whitish scar (Fig. 12).

Case II. *Ulcer of the greater curvature. Cure. Gastroptosis diagnosticated gastroscopically.* Mr. M., aet., 32, had vague symptoms referable to the abdomen, worse after eating, sometimes slightly painful. He had a dread of cancer, upon which his mind dwelt. Ether being given by Dr. E. J. Thompson, I passed the gastroscope with the assistance of Dr. Ellen

J. Patterson, and found an ulcer upon the greater curvature, the ulcer being seen plainly by Drs. Patterson and Thompson. Passing on downward 76 centimetres of the tube passed below the upper teeth, and the pylorus was reached. It was at once apparent that this was a case of gastroptosis. It is the only instance in which I have been able to reach the pylorus. The radiograph (Fig. 16), taken by Dr. Russell H. Boggs, shows the gastroscope in postition, the distal end at the pylorus, which, in this patient, was located in the pelvis. The gastroscope can be forced to this depth by pushing the lower wall of the stomach downward, but no force was used in this case, and this was apparently the usual position of the pylorus. The lack of sharpness is due, not to the lack of skill on the part of Dr. Boggs, but to the respiratory movements. The patient being etherized, he could not hold his breath.

I made an application of argentic nitrate solution. The patient called upon me a month later and claimed to be relieved of all symptoms, felt as well as he ever did, and saw no reason why I should want to examine him again, so that I am unable to verify, as to the ulcer, his claim of cure. As to the gastroptosis, naturally, no change need be looked for.

Case III. *Ulcer of the cardia and posterior wall diagnosticated gastroscopically.* Mrs. Mary A., aet. 53. Brought by Dr. Andrew Hunter, who suspected a stomach lesion on account of epigastric pain, extending backward to a point between the shoulders, and of vomiting without nausea. Ether being administered by Dr. Helen F. Upham, we passed the gastroscope and located a slight resistance at the cardia, with an ulcer about a centimetre in diameter, immediately below it posteriorly. Upon entering the tube three centimetres further, another ulcerated area of greater width located to the right was seen plainly. The upper edge of the upper ulcer was readily made out; also the lower edge of the lower one, but the intervening edges could not be uncovered by very gentle manipulation, so that we were unable to determine whether there were really two ulcers or only two portions of one continuous lesion. There seemed to be cicatrices about the cardia which rendered the exposure of the ventricular mumucosa difficult.

This patient is still under internal treatment by Dr. Hunter, and is improving rapidly.

Case IV. *Malignant disease of the pylorus and greater curvature.* Charles K., aet. 44. Family history unknown, personal history negative, except as to alcoholism. Admitted to the Western Pennsylvania Hospital in the service of Dr. E. B. Haworth. Three months before patient had lost appetite, weight and strength. He complained of epigastric pain, burning in character, worse after eating, occasional vomiting, usually an hour or two after taking food, sometimes of coffee grounds character. A mass about the size of an orange could be palpated, and was thought to be at or near the pylorus.

At the request of Dr. Haworth I passed a gastroscope, under local anesthesia, and in a few minutes located an ulcerating fungoid mass on the greater curvature involving the anterior and posterior walls. The left edge could be followed for about 5 centimetres, and the mass could be explored toward the right for about three centimetres. Fig. 15 in the plate represents the appearance of the left edge rather imperfectly, owing to my lack of skill at color drawing. The image in the gastroscope, however, was just as plain as in the figure. The infiltration shown at the edge of the mass had obliterated the folds at that point.

To the touch of the tube as well as the probe, the mass was hard. Quite unlike the soft yielding of the normal stomach wall. The lesion was examined through the gastroscope by Drs. E. B. Haworth and C. H. Ingram. The patient refused to have a specimen taken for examination. He also declined operation and was discharged from the hospital.

Case V. *Epithelioma of the cardia and lower curvature.* Henry M., aet. 38, admitted to the Western Pennsylvania Hospital in the service of Dr. E. B. Haworth. Family history negative. Personal history negative except as to alcoholism. Six weeks before admssion first noticed pain in epigastrium and at back. Since has been losing weight and strength. Icteroid hue of skin first noticed two weeks before admission. Had vomited twice, and noticed "coffee ground" character each time. A tumor was palpable in the epigastrium about the middle line. Upon passing the gastroscope, the thoracic portion of the esophagus opened normally ahead of the tube, with the respiratory movements, as in Fig. 1 in the plate. When the cardia was reached the tube encountered a hard resisting mass, as shown to the right in Fig. 13. To the left the tissues were normal and the gastroscope was gently insinuated in that diretcion, and it passed the obstruction readily. About two centimetres farther on, an exuberant nodular mass appeared in front of the tube to the right, and evidently was at the center of the hard mass encountered as the tube entered the stomach. The appearance is fairly well represented in Fig. 14. Beyond this mass was a gap, the bottom of which could not be explored. Beyond this gap the folds seemed normal in every direction. A specimen was taken with the tube forceps described above, and was reported upon by Joseph H. Barach as squamous celled epithelioma. Operation was refused, and the patient was discharged.

A diagnosis of malignancy was justifiable, I think, in both of these cases on the gastroscopic results alone, especially the fungating ulcers, the mass and the induration as determined by the touch of tube and probe. True, in these cases, a diagnosis could have been made, indeed, was made by Dr. Haworth, on the history, examination of the vomitus and palpation of the tumors, yet when the diagnostic possibilities of gastroscopy shall have been realized and early opportunities afforded, a diagnosis will be made earlier than is possible by any method other than exploratory operation, consent to which frequently cannot be obtained until late.

Case VI. *Jaw of forceps removed from the stomach by gastroscope.* This is the only case in which I have had an opportunity for the removal of a foreign body from the stomach. While using the forceps as a cotton carrier for swabbing the distal end of the gastroscope, one of the jaws of the forceps broke. The cotton was sufficiently entangled in the other jaw to come out with the forceps, but the detached jaw was scraped off by catching on the distal end of the gastroscope.

Just then the patient, having come partially out from the anesthetic, retched a number of times, during which the ever-moving stomach wrinkled its folds and the jaw of the forceps was lost to view. To make matters worse, I had at hand no other forceps long enough to go through that tube (80 cm.), so I withdrew it. The fragment of forceps became thus, to all intents and purposes, a foreign body at large in the stomach. While, in view of its small size, it did not seem a serious matter should it not be found, yet, because of the sharpness of one end, judging by the point of the fracture, I felt that leaving it involved a certain degree of risk. I then introduced a 70 cm. tube, for which I had forceps at hand. Fully a half hour was consumed in exploring one fold after another of the gastric walls before the foreign body was finally found and removed. This accident need not have occurred and will not occur with me again, as the forceps were damaged for want of a carrying case and should not have been used in their damaged state.

RESUME.

1. *History.* The attempts made 25 years ago to examine the stomach gastroscopically were abandoned because no practical instrument was devised.

2. *The instrument* herewith described renders gastroscopy easy for any one accustomed to work in the esophagus. As with my esophagoscope and bronchoscope, the light is at the extremity of the tube, where its full power is available without loss through distance.

3. *Usefulness.* Gastroscopy is not simply a feat. It has a field of usefulness that will increase as our skill and knowledge increase. Gastroscopy, in my opinion, is useful for the detection and removal of foreign bodies, the diagnosis of many pathologic conditions, as inflammation, ulceration, scars, neoplasms, dilated vessels and the treatment of at least one of these conditions, namely, benign ulcer. When the gastroscope shall have gained its deserved recognition, malignant disease of the stomach will be diagnosticated in many instances sufficiently early to give the abdominal surgeon a fair chance. Better still, a positive diagnosis of precancerous conditions will be made sufficiently early to enable him to save lives that are now being lost through reluctance of the patient to submit to an exploratory gastrotomy. Gastroscopy is not offered as a substitute for an exploratory operation in every instance. But only in those cases in which the patient declines to submit, or in which the surgeon or the physician considers a simple procedure almost free from risk preferable to operative exploration.

4. *Results.* With the gastroscope, I have made a diagnosis or gastritis, gastroptosis, malignant disease of the cardia and of the pylorus, each in one instance. I have made the diagnosis of peptic ulcer in three cases, one of which was cured by direct applications. I have removed one foreign body from the stomach, being a forceps jaw lost therein by myself.

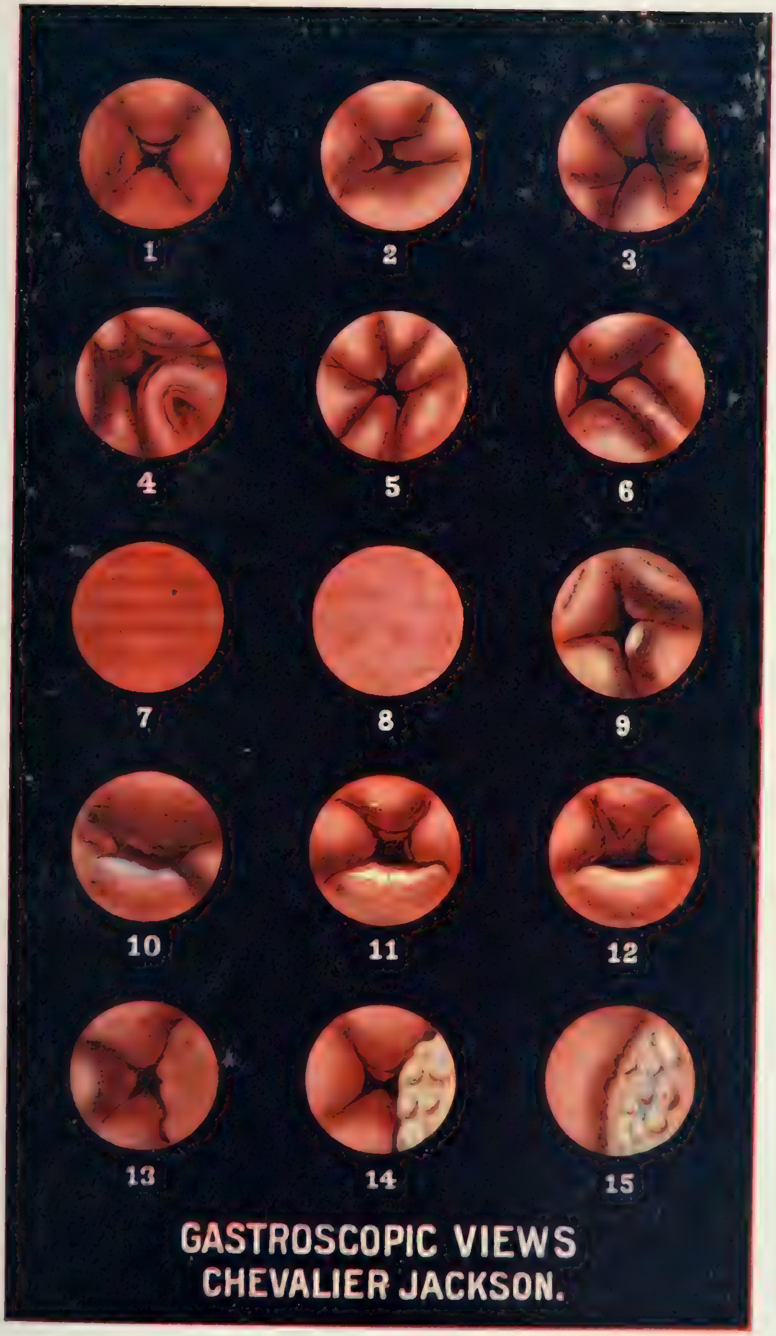
5. *Limitations.* Negative results from gastroscopy are of limited value, because we cannot be certain that no lesion exsts in the unexplorable area. But with greater perfection and skill, this unexplorable area will be very much diminished.

6. *Anesthesia* by ether is preferable. Chloroform is unsafe, and cocain, though an adequate analgesic, does not stop the retching which will interrupt so constantly.

7. *The explorable area,* with a stomach of the classic shape and position, is the middle third. More than a third of the greater curvature is readily seen, likewise of the anterior and posterior walls at their inferior portions, the lateral extent of the field diminishing upward toward the esophageal orifice. The fundus and pyloric ends can be brought within range of the gastroscope by the external assistance of an expert abdominal manipulator, the tube being withdrawn within the esophagus, until the new field is in place. In vertical and gastroptotic stomachs, the lesser curvature, the pylorus and the pyloric third are readily explored with little or no external manipulation.

8. *Dangers.* In a patient with a normal esophagus and stomach, the only danger is that of ether anesthesia. An ulcer of the esophagus or stomach constitutes an exceedingly slight risk unless the ulcer bed be so thin that it would perforate within a few days by erosion or by the normal spontaneous movements of the stomach. In chronic inflammatory states of the stomach, no risks are incurred. In malignant disease a specimen may be taken with little risk in fungating conditions, but in flat ulcerations suspected of malignancy, the biting out of the edge of the ulcer, though very easy of accomplishment, is unjustifiable. The danger of hemorrhage is nil in the normal stomach; in the diseased stomach it exists only in cases which are about to bleed anyway.

The foregoing statement of dangers is based upon gentle manipulations, and the observance of certain rules, the most important of which is the immediate withdrawal of the gastroscope within the esophagus above the diaphragm, should retching supervene, waiting for the re-advent of deep anesthesia before again pushing the tube downward.



GASTROSCOPIC VIEWS
CHEVALIER JACKSON.

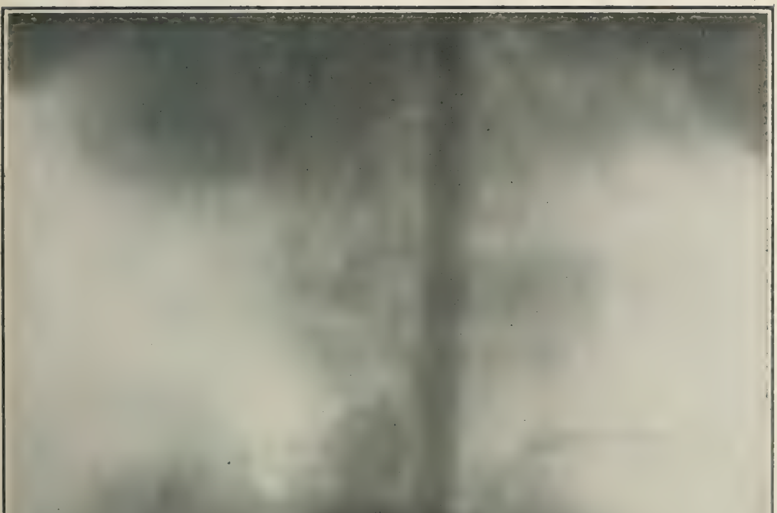


Fig. 16

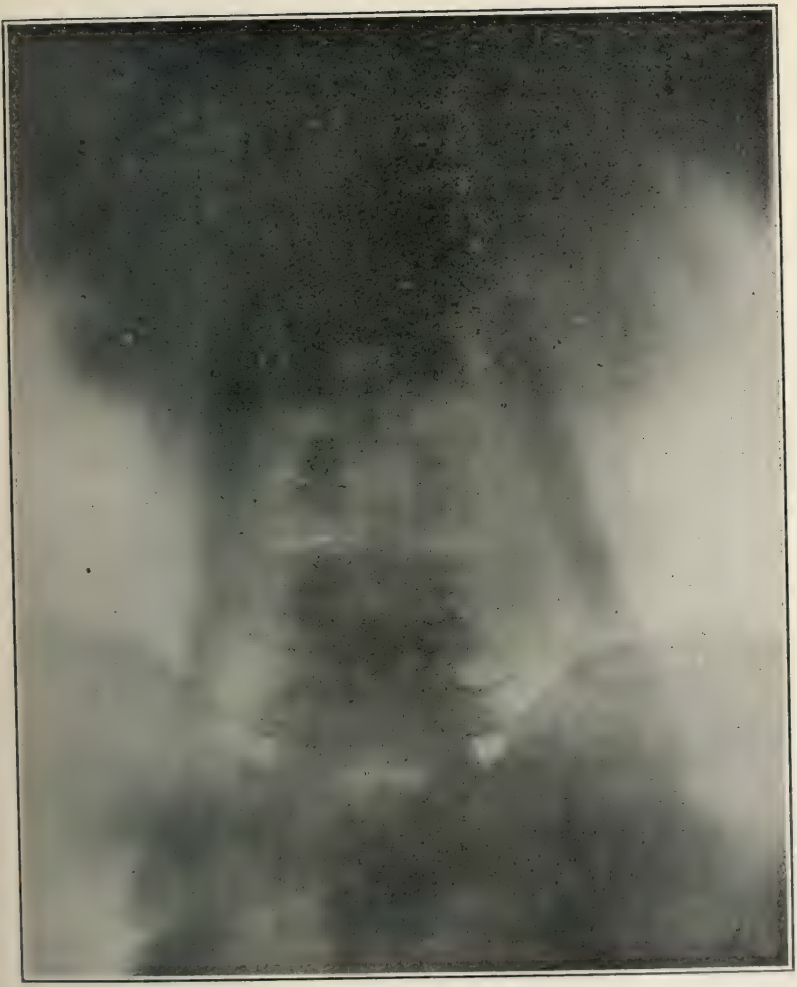


Fig. 20

LVI.

CONGENITAL LARYNGEAL STRIDOR.

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In discussing the subject of congenital laryngeal stridor, it is my intention to limit my remarks to a consideration of the different views that have been advanced regarding the etiology of the affection. Before doing so, however, it is very essential that we should have a definite conception of the clinical features presented by a typical case of congenital laryngeal stridor. A perusal of the literature of the subject reveals the fact that there is sometimes a misconception as to what really are the clinical phenomena of this condition, a misconception which must necessarily lead to some confusion in the study of its etiology.

The symptoms have been accurately described by John Thomson. The infant, who appears in other respects normal, is noticed shortly after birth to have noisy breathing. The noise consists of a croaking sound occupying inspiration, which assumes the character of a high-pitched crow when a more forcible inspiration is taken. Expiration may be accompanied by a short croak when the stridor is loud, but at other times it is noiseless. There are occasionally brief intervals during which no sound is audible even in very severe cases, but with this exception, the stridor goes on constantly while the child is awake, and sometimes even when he is asleep. Emotional excitement or any physical cause of deeper breathing, such as exposure to colder air, or the act of crying, may intensify the sound. The child's power of crying and coughing is unaffected. A feature of very considerable interest in the case is the fact that, although the breathing is noisy, it is not accompanied by the slightest distress, and there is no cyanosis. There is, however, marked inspiratory indrawing of the thoracic and abdominal walls, except in the mildest cases.

The stridor increases in loudness during the first few months, and after remaining about the same for a few months more it gradually lessens and finally disappears during the course of the second year of life.

Various explanations have been offered to account for these clinical phenomena: thus we have a reflex laryngeal irritation induced by the presence of adenoids in the nasopharynx (Robertson, Eustace Smith); pressure upon the trachea from an enlarged thymus (Avellis, Hochsinger); congenital malformation of the upper aperture of the larynx (Lees, Sutherland and Lack, Refslund, Variot, Koplik); an ill coordinated spasmodic action of the respiratory muscles inducing an exaggeration of the normal infantile type of larynx, an acquired deformity (John Thomson and Logan Turner).

1. Adenoid Vegetations. — Eustace Smith has described the origin of the condition to the presence of adenoids and the associated nasopharyngeal catarrh. "I attribute the stridor to a spasmodic contraction of the aryepiglottic folds, and believe that it is due to irritation set up by the adenoids in the nasopharynx." He points out that while the size of the post-nasal vegetations may be insignificant in any particular case, they may none the less be the cause of the symptoms, as the nervous irritation may be produced not so much by the adenoids themselves as by the associated nasopharyngeal secretion. To support his contention, Smith describes a case in which the symptoms were entirely relieved by the removal of the adenoids. The infant aged 1 month had had noisy breathing since birth, and at times the crowing was so loud and the breathing so labored and distressed as to raise fears of the child's life. Suffocative attacks of an alarming nature occurred from time to time, the lividity and distress being so great that immediate tracheotomy appeared imminent. On account of a suffocative attack of exceptional severity the child at the age of 3 months was admitted to hospital. The adenoid vegetations were removed, and in a very short time the noisy breathing ceased and there was no return of the threatened suffocation.

One is at once struck in the description of this case with the fact that the clinical picture differs in one very essential feature from the classical cases of congenital stridor, namely, in the occurrence of severe attacks of dyspnea accompanied by cyanosis, and by the evident distress which the infant at times labored under. Suffocative attacks of this nature are extremely rare in connection with cases of congenital stridor, indeed with the exception of one of the fatal cases reported by Sutherland and Lack, we are not aware of any reported case of congenital stridor being accompanied by serious symptoms of this kind. That adenoid vegetations and their associated catarrh will produce attacks of difficulty in breathing, sometimes of an alarming nature, is quite well known, but such cases, to which that described by Smith corresponds, cannot be classified under the term congenital laryngeal stridor. Further, adenoids are very rarely met with in cases of congenital stridor, and when they are oçcasionally present their removal does not influence the character of the breathing.

In none of the cases examined by Sutherland and Lack were the tonsils much enlarged, nor were there adenoid vegetations of any importance. In none of them were the sypmtoms usually associated with such lymphoid hypertrophy present. Thomson did not find adenoids in his cases: in one of Variot's there was a small mass in the nasopharynx, but its removal made no difference in the stridor. In regard to only one of the eleven cases published by Massei, was the statement made that adenoids were present.

2. COMPRESSION OF THE TRACHEA BY AN ENLARGED GLAND.—In order to estimate what value can be attached to the views of Avellis and Hochsinger as to the origin of congenital stridor from compression of the trachea by the thymus, it is necessary to consider first, whether the trachea can be compressed by that gland, and, secondly, if such compression can be regarded as the causal factor in the production of the affection.

Both clinical and post-mortem evidence certainly appear to show that an enlarged thymus can compress the trachea and produce respiratory difficulty.

Clinical evidence is to be found in the small number of reported cases in which the respiratory embarrassment has been relieved by an operation upon the thymus. Thus Theodor, Siegel, Koenig, Perrucker, Moritz-Schmidt and Morse have reported cases in which the thymus has been exposed and the gland either in whole or in part removed, or stitched to the periosteum covering the upper end of the sternum. In Theodor's case, the operation was performed by Ehrhardt; in Siegel's and Schmidt's cases, Rehn was the operator, and in the case reported by Morse, the operation was done by Murphy. I have not been able to find the report of more than seven cases operated upon. In six of them the operation proved successful, the difficulty in breathing being relieved. In Morse's cases in which the thymus was stitched, immediate relief was obtained but the symptoms recurred in a few days and the child gradually sank and died.

Post-mortem evidence of tracheal compression is also obtainable, but in selecting evidence of this kind I have been careful to cite only those cases in which it was distinctly stated that compression of the trachea was observed after death. This is very necessary for the reason that there are many cases in which at the autopsy the thymus is described as enlarged and death is believed to have been due to compression of the trachea without any actual evidence of the same. In Marfan's case, the trachea was found almost completely flattened by the hypertrophied thymus. Weigert also succeeded in demonstrating tracheal compression. In Massei's case a similar appearance was observed.

Sufficient evidence in support of the contention that the trachea may be compressed by an hypertrophied thymus has been recorded.

It is now necessary to determine whether such compression can be regarded as the etiologic factor in cases of congenital stridor. It is advisable at this point to quote briefly two of the cases of thymus compression, selecting one in which an operation was performed for the relief of the dyspnea, and one in which there was post-mortem evidence of compression.

Theodor's case, an example of the first, was that of a child aged 2 years, strong, pretty well nourished and with no evidence of rickets. For four months it had suffered from attacks of dyspnea, with cyanosis. The intervals between the attacks became shorter and the dyspnea increased in severity. It was accompanied by indrawing of the intercostal spaces and suprasternal notch—the stridor was present in both respiratory acts. Intubation failed to relieve the distress. The thymus was removed by Ehrhardt and there was no further respiratory difficulty. Massei's case was that of an infant 4 days old. There were sudden and violent attacks of dyspnea, bordering upon asphyxia: these followed each other at intervals, their duration being about five minutes. Cyanosis, turgescence of the veins of the neck and great distress were present. Death occurred after three days, and the autopsy revealed a very large thymus compressing the trachea.

It is at once evident that these cases present a very different clinical picture from that which we associate with congenital laryngeal stridor, so that it is difficult to believe that the same causal factor can be present in the two classes of cases.

It is necessary, therefore, to analyze the evidence brought forward by Avellis and Hochsinger in support of their contention. The cases described by the former in his paper correspond in every respect to the recognized clinical picture of congenital laryngeal stridor. Avellis argues that the approximation of the aryepiglottic folds in such cases is consequent upon a deeper lying stenosis, and is comparable to the tucking in of the alae nasi in cases of nasal or post-nasal obstruction. No clinical or post-mortem evidence is advanced by him to support this assumption. In his cases there are no attacks of dyspnea, no cyanosis and no real respiratory distress which form so essential a feature of the authentic cases of thymus compression of the trachea; in addition to the greater respiratory distress associated with thymus compression, the stridor is mainly of an expiratory type and the up and down movements of the larynx are restricted or absent when the trachea is stenosed. In Avellis' cases these features are not present.

Hochsinger, too, is of the opinion that the condition known as congenital stridor is due almost exclusively to compression of the trachea by an hypertrophied thymus, and that the stridor is produced in the trachea. He supports his contention by the aid of two clinical methods, radiography and percussion. Out of fifty-eight infants in whom a radiogram was taken, the thymus was regarded as hypertrophied in twenty-six. In twenty of the latter there were symptoms of congenital stridor. With our knowledge of the great variations both in the size and in the weight of the thymus, and our knowledge of the fact that along with considerable hypertrophy of the gland, there may not be the least interference with respiration, it would obviously be injudicious to attach too much importance to the evidence furnished by the X-rays, and by percussion.

Further, we have analyzed the notes of ten published fatal cases of congenital stridor, and in only one of them, namely, in Koplik's case, is the thymus stated to be enlarged, and in it there was no evidence of tracheal compression. In five of the cases the gland is described as not being hypertrophied, while in the remaining four, no mention is made of its condition. In the four latter, it is reasonable to suppose that the gland presented no abnormal appearance. In typical cases of congenital laryngeal stridor, therefore, there is no post-mortem evidence that the thymus plays any part in the causation of the stridor. Until more evidence can be brought forward we are unable to accept the view of Avellis and Hochsinger.

3. CONGENITAL MALFORMATION OF THE UPPER APERTURE OF THE LARNYX.—Sutherland and Lack are of the opinion that congenital laryngeal stridor is dependent upon two factors, viz., a peculiar congenital malformation of the upper aperture of the larynx and the flaccidity of the structures which form that aperture. In six cases in which they made a laryngoscopic examination, the epiglottis was found sharply folded upon itself, its lateral margins being in close apposition and in some cases in contact. The aryteno-epiglottidean folds were approximated and thus the upper aperture of the larynx was reduced to a small slit. The thin folds bounding it seemed quite flaccid and flapped to and fro on respiration. In only a few of the cases could a view of the vocal cords be obtained. In one of their fatal cases the epiglottis was soft and folded inwards, but no structural change could be detected in the larynx on microscopic examination. While a certain amount of deformity of the upper aperture is essential for the production of the stridor, the valvular action produced by the flaccidity of the soft parts forming its boundary is also necessary to cause the obstruction.

The stridor is produced by the approximation of the ary-epiglottic folds; as the respiratory column of air enters the larynx, the folds already lying closer to each other than in the normal infantile larynx, become approximated. The fact that they are wider apart at the commencement of respiration but become more closely approximated as the act progresses bears out the observation that the stridor becomes higher pitched at the end of respiration when the folds are nearer together. Sutherland and Lack state further that as the child grows the malformation remains, but the stridor passes off because the parts forming the upper laryngeal aperture become less yielding. They found the malformation persisting as long as the cases remained under observation, in one case up to the age of 6 years. Occasionally a similar malformation is met with in advanced life, but they could bring forward no evidence that such cases had suffered from stridor in infancy.

Other writers have expressed similar opinions with regard to the pathology of congenital stridor. Lees depicts the larynx of an infant aged 1 year, who had suffered from stridor since birth and died from laryngeal diphtheria. The deformity was of a very marked type. Refslund describes the larynx of infant aged 2½ months who had been the subject of persistent crowing from birth. Death occurred from pneumonia, and post-mortem examination showed that the upper laryngeal aperture was reduced to a mere slit. Variot's patient was a boy aged 1 year and 10 months, who commenced to suffer from inspiratory stridor shortly after birth. He died from scarlet fever, and the upper aperture of the larynx showed a lesser degree of the deformity than that which is figured in Refslund's case. Haushalter has published the history of a child who died at the age of 8 months from bronchopneumonia. Two days after birth, inspiratory stridor was noticed. At the autopsy the upper laryngeal aperture was considerably narrowed. The epiglottis was rolled backwards upon itself, its lateral borders being in contact. It presented somewhat the appearance of a funnel, only a small opening being left at the apex of the epiglottis. The aryepiglottic folds were also approximated and the arytenoid cartilages lay more closely together so that the interarytenoid fold was effaced.

In Koplik's case, to which reference has already been made, death took place at the age of 1 year from extensive bronchopneumonia. Symptoms of laryngeal stridor were first noticed three weeks after birth. The upper laryngeal aperture showed a well-marked example of deformity, the epiglottis being curved backwards with its lateral borders almost in contact. The arytenoid cartilages and aryepiglottic folds were also approximated, the latter being thin and membranous, so that the upper aperture of the larynx was represented by a mere slit.

In all these cases presenting symptoms typical of the clinical picture of congenital laryngeal stridor, the appearance of the upper aperture of the larynx had been ascertained by post-mortem examination. Death occurred as a rule from intercurrent respiratory affection. In all of them a very similar and characteristic malformation varying only in degree was observed.

It is regarded by these observers as a congenital malformation. The clinical features present in all of them were typical of the classical picture of congenital stridor. The attacks of dyspnea and cyanosis which form so marked a feature in cases of compression by the thymus were not observed in these cases. In studying the illustrations of the larynx figured in the fatal cases of Lees, Refslund, Haushalter and Koplik, one cannot fail to be struck with the marked deformity of the larynx. It is difficult, indeed, to believe how respiration could have been carried on without any dyspnea or cyanosis accompanying it. They are drawings, however, and not photographs. In Variot's case which has been photographed, on the other hand, the deformity is not nearly so marked.

4. An Acquired Deformity of the Upper Aperture of the Larynx, the Result of a Disturbance of the Co-ordination of the Respiratory Movements.

John Thomson regards the primary element in the causation of congenital laryngeal stridor to be a disturbance of the co-ordination of the respiratory movements, probably due to some developmental backwardness of the cortical structures which control them. As a result of the ill co-ordinated and spasmodic nature of the breathing, a change takes place in the upper aperture of the larynx. There is a constantly recurring sucking in of the soft structures which form the aperture, so that an exaggeration of the normal infantile type results,

THE LARYNX IN THE INFANT.

In order to make the above statement more clear, it is necessary to consider both the type of the larynx and the character of the respiration in infants.

For this purpose Thomson and the writer examined a number of larynges from still-born infants and from children up to the tenth year of life. Some of them were examined *in situ* by means of a dissection which exposed the larynx from behind, while the remaining larynges were studied after their removal from the body by the *post-mortem* method. Our attention was directed mainly to the upper aperture of the larynx. The structures forming the boundaries of this space, namely, the epiglottis in front, the tips of the arytenoid cartilages and the interarytenoid fold behind and the epiglottic fold laterally, were found to be much softer and more collapsible than they are in the adult. In addition to the evidence of this as furnished by the handling of the parts, it was observed that the upper aperture of the larynx of the still-born infant was relatively wider than that of the infant which had breathed. In the latter the space is narrower from side to side, owing to the folding backwards and inwards of the epiglottis with the consequent drawing together of the aryteno-epiglottidean folds. This is due to the soft collapsible character of these structures acted upon by the inspiratory air current. The form of aperture thus produced constitutes the infantile type of larynx, which has been described by Merkel, Luschka and other anatomists. As the child grows, a change takes place in the form of these parts, the epiglottis becomes more expanded, the aryepiglottic folds are separated and the upper aperture is in consequence broadened. At the age of 3½ years the opening of the larynx is wider, while at 9 years of age the infantile type has almost entirely disappeared.

While varieties are met with in different infantile larynges, at the same period of life, all of them possess in a more or less marked degree the characteristics above described. These peculiarities combine to make the upper aperture of the larynx liable to changes in form under the action of influences which have no corresponding effect upon the adult organ. The most important influence of this kind is a sudden drawing of air into the larynx. In the larynges of the new-born children and very young infants, the effect on the larynx of drawing in air can be easily demonstrated after death by a simple experiment. A bent metal tube is introduced into the trachea, and in order to open up the chink of the glottis a piece of rubber tubing is placed between the vocal cords. Forcible inspirations are then made through the tube, when it is found that with each, a striking alteration in the form of the upper aperture of the larynx occurs. The exact change varies in different cases, but the following main types may be noted:

1. In some cases the lateral margins of the aperture become sucked together so that merely a narrow mesial slit is left between them.
2. In others the epiglottis is drawn backwards and downwards so as to act as a lid to the aperture.
3. In others again the arytenoid cartilages meet in the middle line, the margins of the anterior part of the aperture remaining unaffected.

When this experiment is repeated several times upon the same larynx, one observes that the upper aperture retains to a very considerable degree the deformity which the suction has produced. Thus, when the aryepiglottic folds are drawn in so that a vertical mesial slit is left between them, they are found after a few experiments to be permanently nearer one another. We were further struck by the fact that in some of the experiments the form assumed by the upper laryngeal aperture closely resembled the deformity which has been figured in the fatal cases described by Refslund, Thomson and others. In Thomson's case, an infant dying at the age of three months, the epiglottis was folded back in such a way that its lateral margins were in contact and the aryepiglottic folds approximated so that only a narrow slit was left between them. In other words, the malformation which has been regarded by some writers as a congenital one, can be acquired by such a simple experiment as that just referred to.

The objection will doubtless be raised that such experiments conducted upon the cadaver cannot be regarded as entirely trustworthy, because the exact conditions which exist during life are not present. We would, however, again emphasize the fact that the aryepiglottic folds which are mainly concerned in the production of the deformity, contain only a few muscular fibres, and are thin, lax folds of mucous membrane which are readily acted upon by such a mechanical force as the sucking in of air between them. Further, it is well known to all who have attempted to examine during life the larynx of healthy infants and young children, that the aryepiglottic folds tend to become approximated when the child forcibly inspires during the examination—that is to say, that the structures can assume in the living body the same position that they can be made to take up in the cadaver and as a result of a similar cause.

RESPIRATION IN THE INFANT.

In very young children the respiration under normal conditions is peculiar in being irregular in rhythm and in force, as if the co-ordination involved in its movements were not as yet under full control. There often occur, therefore, relatively sudden respiratory efforts. When a young baby is excited, it is no uncommon thing for it to develop a temporary crowing noise with inspiration, although it has none at other times. A similar but louder and more persistent crowing, which exactly resembles that in a case of infantile stridor, is not infrequently observed in young infants while they are beginning to come out of chloroform narcosis, and a similar loud crowing is a not uncommon accompaniment of operations on the genital organs, owing to the sudden forcible inspiration which the stimulation of the nerves of these parts brings about. Along with the crowing there is always a degree of indrawing of the lower chest wall proportionate to the loudness of the crow.

It is evident, therefore, that in infants in whom the respiratory conditions are normal under ordinary circumstances, there may be produced by any cause which will bring about a sudden and increased inspiratory effort, a crowing respiration similar to that which is observed in cases of congenital laryngeal stridor. This is due to the soft, collapsible nature of the structures forming the boundaries of the upper aperture of the infantile larynx. In the typical stridor cases, owing to the ill-conditioned and spasmodic character of the breathing, which forms the primary element of disturbance in these cases, there is also produced a narrowing of the upper laryngeal aperture and a consequent more or less constant condition of stridulous breathing, the same as occurs temporarily in normal children. We believe that the sound is produced mainly at the abnormally approximated aryepiglottic folds. The inspiratory croaking and crowing sounds vary in loudness according to the vigor of the inspiration. It is never constantly present, there being always occasional free intervals.

There appears to be sufficient anatomical, clinical and experimental evidence, therefore, in favor of the view that an acquired deformity of the upper laryngeal aperture, the result of an ill co-ordinated type of respiration, is probably the cause of the condition known as congenital laryngeal stridor.

LVII.

CHANNELS OF INFECTION IN TUBERCULOSIS.

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The subject under consideration is of such magnitude, that it is impossible to give a complete review, and many important points can be alluded to only briefly. Therefore it was necessary to refrain from treating of the infections of the skin, of the large visceral glands, the bones, the nerves and the uropoetic system, and to confine myself to the respiratory and digestive organs.

Before entering into the subject, a few remarks will not be amiss, which, although containing no new data, contribute to a better conception of infection in general, and allow of a shorter discourse of the separate chapters.

We distinguish the human, bovine and avian bacillus, but cannot enter into their differentiation, beyond stating that the cultures of the avian bacillus require 103° F., those of the human and bovine bacillus 98°. Of the animals generally used for inoculation, the rabbit is very slightly susceptible to the human, decidely so for the avian and still more for the bovine bacillus. The guinea pig is highly susceptible for the human and bovine, but not for the avian bacillus. The virulence of the bacillus is enhanced by repeated transmissions through the susceptible animal, but diminished by successive cultures upon glycerin-bouillon.

The existence of the bacillus, only, is not sufficient for the diagnosis of tuberculosis; in addition, the presence of morphologic changes which demonstrate its pathogenic effect is necessary. Further, we must always keep in mind that the tubercle bacillus can not only enter, but also pass through the microscopically intact mucous membrane, without leaving a trace at the point of entrance. They become then localized in the mucous membrane or more frequently in a neighboring lymphatic gland, for instance, in a mesenteric gland in intestinal infection, and in case of calcification and encapsulation remain innocuous indefinitely. But when caseation and disintegration take place and the bacilli enter the lymphatic system, they can settle in any organ and produce tuberculosis. This peculiarity of the tubercle bacillus renders the determination of the primary lesion often difficult for the pathologist even in initial cases, and is also partly the cause of the diversity of opinions of the investigators as to the channels themselves and the frequency of the different types of infection.

Two other topics, about which the authors are at variance, are the duration of latency of the tubercle bacillus in the human body till tuberculosis develops, and the relation of the human and bovine bacillus. Robert Koch, in his well-known address at the British Tuberculosis Congress in London, 1901, pointed out the pathogenic difference between the human and bovine bacillus and the non-susceptibility of cattle to the former. His assertion was based on many experiments, viz., several animals received injections of tubercle bacilli under the skin, into the abdominal cavity, into the jugular vein, six were fed with bacillar sputum during seven to eight months, four animals inhaled large quantities of bacilli suspended in water. None of the nineteen cattle became diseased, they gained in weight, and when killed after six to eight months, no trace of tuberculosis was found in the internal organs; only small abscesses containing a few tubercle bacilli had formed at the point of injection. The reverse experiment on man being excluded, and having only once been made in Koenigsberg, with negative results, more than twenty years ago in six incurable cases of carcinoma (Baumgarten), Koch reasons, that primary intestinal tuberculosis from ingestion would be more frequent in view of the large quantities of milk and butter consumed, which very often contain living bacilli of pearl disease if the bovine bacillus was harmful to man. But Baginsky never found intestinal tuberculosis without such of the lungs and bronchial glands in 933 post-mortems of tuberculous children, and Biedert only sixteen cases of primary intestinal tuberculosis in 3104 post-mortems. If, therefore, a susceptibility of man for the bovine bacillus exists at all, Koch concludes that the danger of infection from milk and butter, etc., is very small, but at the same time recommends repetitions of his experiments, which were made by several investigators and with varying results. Not being able to enter into details we mention only, that in quite a number of instances the transmission of tuberculosis to cattle by the human bacillus was successful, although other authors did not consider these experiments free from error; for instance, on account of intraperitoneal or intravenous injections.

The results of the extensive experiments of the German Imperial Health Bureau, which were also used as an argument against Koch, were analyzed recently by Weber in an article in the text book of the pathogenic microorganisms. He states, that inoculations of cattle with human bacillus produced infection near the point of injection, the shoulder gland, which sometimes became as large as a goose egg, but that the human bacilli did not progress any further, and that the gland entered retrograde metamorphosis after a few months. Inoculations with bovine bacillus were followed by continuous dissemination, leading to progressive tuberculosis.

In a later paper (*Brit. Med. Jour.,* December 20, 1902), Koch enumerates additional data in support of his views, and analyzes and refutes the validity of the cases reported by his opponents. He explains the great difference in the frequency of primary intestinal tuberculosis, found by various authors, by the difference of subjective opinion as to what is understood by this infection. He draws attention to the observation, that when a case of tuberculosis has occurred in a family or locality, where milk of a diseased cow has been used, other members of the family or group of persons would necessarily also have become infected, whilst the instances mentioned by authors are confined to isolated cases, and the other persons subject to the same infection remained well.

The assumption seems at least feasible, that the final results of future experimentation will show, that the human bacillus produces in cattle localized tuberculosis, not becoming a general infection, and that the same modus will hold good in reverse order for the human race. But till this important question has been definitely settled, the continuation of prophylactic measures, viz., boiling of milk, supervision of cattle, has to be recommended.

Before concluding these general remarks, the relation of tuberculosis to the consumption of milk, the mortality at different ages, hereditary, should be briefly considered. The mortality in tuberculosis in Sweden and Norway, where almost all mothers nurse their children, is greater than in Germany. It is also high in Havana, China, the Philippines, in which countries very little milk is consumed. The same condition prevails in Japan, where, according to Kitasato, the proportion of cows to population is 5 to 10,000, and where the higher classes do not drink milk. How easily erroneous deductions are sometimes drawn from insufficient observations, is shown by the often cited case of Ollivier, in support of milk infection, which was reported in the Bulletin of the Paris Academy of Medicine in 1891. In a boarding school thirteen girls acquired tuberculosis within four years, and six of them died. The cow belonging to the school, when killed, showed extensive tuberculosis, from which a milk infection seemed evident. But on further investigation it was proven that the milk had always been boiled, had been used in small quantities only or not at all by the girls but principally by the teachers and servants, who all remained well. One of the thirteen girls could not have been affected by the milk, as she had left the school before the cow was purchased.

Naegeli (*Virchow's Archiv.*, Vol. 160) made eighty-eight post-mortems of children from 1 to 18 years and of 420 adults in search of the presence of tuberculosis, and states the pathologic conditions justifying him to assume its existence. He found fifteen tuberculous changes or 17 per cent in the eighty-eight children, of which fifteen cases only five had been diagnosed in life. In twelve new-born and those having died within the first year, no tuberculosis could be detected. Of the 420 post-mortems of adults, only the later, second series of 284 was considered, having been more carefully executed. Only six of the whole number were found without tuberculous foci, and in sixty-three cases the disease had been fatal. Naegeli's statistics, which had also been accepted by other authors on account of their accuracy, show not only the preponderant mortality after the seventeenth year, but also that at one time of his life almost everybody had a tuberculous lesion.

Naegeli's figures are confirmed according to a quotation of Behring (*Deut. med. Wochenschrift,* No. 39, 1903) by the investigation of the Austrian army surgeon, Franz. He made tuberculin injections into the soldiers of two regiments, using the small dose of 3 mgr. to prevent ill sequelae, and 5 mgr. if repetition was necessary. He found in the regiment of soldiers serving their first year 61 per cent, of those in the second year of service 68 per cent reaction.

The statistics of the twenty-one authors quoted in Cornet's handbook, "Die Tuberculose," who believed phthisis to be hereditary, vary between 10 and 85 per cent. This great discrepancy is due to the elastic personal conception of heredity and cannot withstand scientific criticism. It is unnecessary to mention the change of views during the last decades, and two considerations will suffice for our purpose. Kuthri investigated the ratio of presence of tuberculosis in parents of tuberculous and non-tuberculous children. In the former, tuberculosis of the father was present in 10.5 per cent, of the mother in 9.9 per cent, of both parents in 2.1 per cent; in the latter, with non-tuberculous progeny, the father showed 9.2, the mother 9.2, and both parents 1.0 per cent; therefore, the greatest difference was 1.4 per cent when both parents had tuberculosis. Further, all cases must be disregarded in which the parents were in good health at the time of generation and birth of child, and became diseased ten to twenty years later, possibly due to infection from the child. The consensus of the opinion at the present time will approve the deduction of Cornet, when he says that heredity cannot be considered an important factor in the development and dissemination of tuberculosis.

Each classification of the channels of infection has the drawback, that some chapters touch upon the same ground and overlap each other. The most scientific division would be into primary and secondary infection, which necessitates a twofold analysis of each type of infection. If arranged by organs, repetitions can also not be avoided, and I thought an arrangement upon the clinical basis to be most suited for practical requirements. The subject is, therefore, divided into infection by inhalation, by ingestion, and into lymphatic and hematogenous infection. After these lengthy introductory remarks, reflections intrinsic to each type can be avoided.

I. Infection by Inhalation.

The difference of opinions of authors mentioned above are nowhere more apparent than in the present chapter, as some do not consider inhalation a source of infection at all, or in rare instances only, others as the most frequent cause. The reasons for these different views are most likely the various opinions that infection can be accepted as caused by inhalation. When the unimpeachable proof, according to Orth, that tuberculosis in man originates by inhalation of bacilli is demanded, it is impossible in the established disease to ascertain how the process has developed. But Orth also concedes the possibility, that repeatedly inhaled bacilli can penetrate the lungs, even alveoli, in spite of the natural protection by the ciliary epithelium, the discharge of the mucous membranes. Birsch-Hirschfeld, Cornet, A. Fraenkel, Lubarsch, believe in direct infection from inhalation. But we will not be amiss when using the term "inhalation" in a broader sense, and extend it to infections caused by inhaled bacilli, although we must concede, that in most cases the initial lesion does not occur at the place of entry, but in some part of the lymphatic system, as we have as an example tuberculous children, whose bronchial glands are frequently affected without lesion of the lungs.

Although we cannot enter into the different types of infection, we must mention the infection by impalpable sputum, so frequently mentioned in recent years. As to the individual organs, the infection of the nose must not be overlooked, which is produced by the contact with the fingernails, as they often contain bacilli in already diseased persons. But it is a well-known fact, that the infections occur the more frequently, the farther away from the beginning of the respiratory tract they take place. The nose enjoys special protection by its well developed ciliary epithelium, its easily excited reflex, its mucus inimical to bacterial life. The meninges can be invaded by communicating lymphatic vessels of the nose. The infections of the pharyngeal tonsils have received so much attention recently, that their knowledge will be familiar to all of us, a difference of opinion only existing as to their frequency. The faucil tonsils will be considered in the next chapter.

II. Infection by Ingestion.

The observation stated in the beginning, that tubercle bacilli may produce tuberculosis in other organs without leaving a trace at their point of entrance, is more frequently made in infection by ingestion than otherwise. To corroborate this statement, and to establish the true path of the infection under natural conditions, Weleminsky (*Berl. klin. Wochenschrift*, No. 37, 1903) fed seven rabbits and seven guinea pigs from eight to twenty days with cultures of human bacilli of moderate virulence, and killed the animals in the interval of twenty to eighty days. Three of the seven rabbits remained well, one showed infection of the intestinal and respiratory tract, three of the latter only, and none of the intestinal. The guinea pig, being so susceptible to the human tubercle bacilli, is put by Weleminsky on a parallel with the vulnerable intestines of children, and he found, in every animal, disease of the intestinal and respiratory tract. But the stage of the diseased foci, which always showed infection of the submaxillary glands, and a more progressive stage in three animals, proved the primary and independent infection of the respiratory tract.

Several authors published primary infections of the pharynx, also of the esophagus, amongst them the writer of a very severe case of primary pharyngeal and laryngeal tuberculosis, which never presented tuberculosis of the lungs or other organs and remains cured now after sixteen years. But the infection of these parts is in the majority of cases of a secondary nature. The faucial tonsils and especially their crypts are not only a frequent portal of entrance of the bacillus, without necessarily becoming primarily diseased, but they are also exposed to infection from the coughed-up bacillary sputum. Primary intestinal tuberculosis has already been mentioned, but the opinions differ as to its frequency.

A new and unique type of infection has been promulgated by Behring at the meeting of the natural scientists at Cassel, 1903, and enlarged upon in the Berlin Medical Society, 1904. Briefly stated, he believes that the milk of the infant is the main source of infection, that the infection therefore results, in the infantile period, in the intestinal tract from the bacilli of the cow's milk, which bacilli remain latent for years in the lymphatic vessels and glands, till they finally enter the lungs through the blood. This opinion is so new and heterogeneous to the views hitherto accepted, that even one of his adherents finds it opportune to explain possible erroneous conceptions. He says, that Behring did not assert that the infantile infection was due only to bacillar food from the cow, as the bacillus could easily be carried into the milk in dwellings of tuberculous patients (a source of infection known long ago). He further did not consider the infantile infection as the only cause of a later tuberculosis, but it predisposes to the latter. As the present paper is not intended to be a critic, but a resume of the opinions held at the present time, only a few adverse opinions will be quoted. B. Fraenkel said in the discussion following the Berlin essay of Behring, that although pulmonary tuberculosis can follow an intestinal infection, the tubercle bacilli generally leave traces before reaching the thoracic duct, and that nevertheless the mesenteric glands show less frequently tuberculous deposits in children than those of the chest and neck. He adds that Behring's opinion diverted us from approved methods of prophylaxis. Baginsky said that children predisposed to tuberculosis die of the disease in their infantile period in rare instances, and if so, we find seldom infection of the mesenteric, but without exception such of the bronchial glands. A few of the arguments of Behring's opponents, who seem to outnumber his adherents, are: the at least doubtful nature of the pathogenic effect of the bovine bacillus on man according to Koch, the probabilities of other paths of infection as proven by many observers, the assumption, incompatible with our present views, of the necessary latency of the bacillus, extending in some cases from fifteen to twenty years up to the outbreak of the disease.

III. Lymphatic Infection.

The important and prominent part, which is assigned to the lymphatic vessels and glands in infection, has been sufficiently emphasized in the two preceding chapters, to obviate the necessity of entering into details. But it may be in place to relate the lucid description of Cornet in his book cited above, how the bronchial glands become primarily infected. He shows the process by the example of inhalation of coal dust, the largest quantity of which will first be deposited in the upper air passages, less in the lower ones and least of it in the lungs. After a few hours or days the upper parts become free in consequence of the ciliary epithelium and the secretory current, whilst the lower remnant is still present and remains, if not transmitted to the bronchial glands by the lymphatic vessels. The aveoli, devoid of ciliary epithelium, are being relieved of the coal particles through the lymphatic vessels in the direction of the bronchial glands, which become filled with the coal dust. A rare channel in intestinal infection is through the mesenteric, respectively retroperitoneal glands, which latter communicate with the bronchial glands through the superficial glands, emptying into the deep cervical ones. The lymphatic path, which the bacilli follow at infection of the faucial tonsils, has received the attention of many authors during recent years.

IV. HEMATOGENOUS INFECTION.

A true, primary hematogenous infection occurs only in utero in consequence of the placental transit of tubercle bacilli to the fetus, and the first authenticated case is described by Schmorl and Birsch-Hirschfeld in "Ziegler's Beitraege zur pathologischen Anatomie, 1891." Such infections are very rare, and up to 1905 only twelve positive cases have been published. But Schmorl found at post-mortems nine time tuberculous foci in twenty placentas of tuberculous women, or 45 per cent.

A secondary hematogenous infection takes place, when a tuberculous deposit, for instance in a gland, breaks down, and its contents are carried into the blood vessels. An exquisite example is the acute miliary tuberculosis. Hematogenous infections of the lungs of a milder, less extended character can be caused by transmission of tuberculous foci of the walls of the blood vessels or of remoter organs. Tuberculous affections of the large visceral glands, of the spleen, liver, kidney, of the bones, joints, thyroid gland and peritoneum, are principally based on hematogenous infection.

If I now conclude this condensed review, I am well aware that in many instances I had to confine myself to a mere allusion to interesting features, in order to be able to give a resume of a subject of such vast extent and importance.

LVIII.

SARCOMA OF THE NOSE, WITH A CONSIDERATION OF THE SPONTANEOUS DISAPPEARANCE OF MALIGNANT GROWTHS.

By Robert Levy, M. D.,

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DENVER.

On the 15th of November, 1903, Mrs. C., aged 73, mother of a physician, was first examined by me for the purpose of determing what, if anything, could be done to relieve her. She gave the following history:

About March, 1903, symptoms of what appeared to the patient to be a cold presented themselves. There were slight discharge and some difficulty in breathing, particularly through the right nostril. There was no pain and no bleeding from the nose, the discharge being of a muco-purulent character; at no time during the history of the case was there any nasal hemorrhage. The difficulty in breathing became more marked in April and was complete about August 1st, 1903, compelling the patient to breath through the mouth. A mass completely filling the right nostril was discovered by the patient's son, and a small piece removed and submitted for microscopic examination to Dr. W. C. Mitchell of the Denver and Gross College of Medicine, who reported June 2nd as follows:

"In reference to the examination of nasal tumor for Mrs. C., I beg to report as follows: The entire mass consists of small, round cells with little if any basement membrane discernible. Histologic diagnosis, small, round-celled sarcoma.

Yours respectfully,

W. C. Mitchell."

June 2nd, 1903.

(See Fig. 1.)

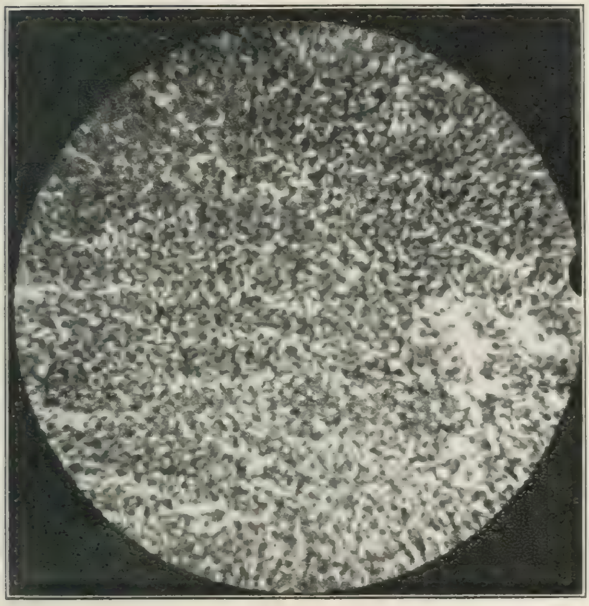

Fig. 1.

A number of physicians being consulted, the case was pronounced inoperable and the patient placed upon a course of iodid of potassium continued over a period of two months. The result of this treatment was negative. From August 8th until September 4th, the patient was given Coley's erysipelas toxins, the result being also negative.

My examination revealed a large, pale, nodular tumor filling the entire right nasal fossa, deforming the nose so that it was enlarged and flattened and deflecting the septum markedly to the left. The tumor extended from the anterior to the posterior naris. There was no ulcerated surface to be seen and no evidence of hemorrhage. The left tonsil seemed to be entirely free from involvement, being, however, decidedly narrowed by the deflected septum. An unfavorable prognosis was given, especially in view of the very positive microscopic report and a radical operation suggested as the only resort.

Upon consultation with Dr. Freeman, it was decided that the case was entirely too discouraging to warrant surgical interference.

On December 2nd the patient again presented herself, begging for at least some relief. I decided to remove enough of the growth by the intranasal route to relieve at least slightly and temporarily, the nasal stenosis. The operation was performed in two sittings. December 22nd and 29th, by means of cold wire snare, galvano-cautery snare, scissors and forceps. The bleeding was profuse, but the tumor was found to be less adherent than anticipated, and the right tonsil was thoroughly cleared of all suspicious tissue. Several days later the galvano-cautery was freely applied to the small projecting nodules in the roof and external wall of the nose. The patient now improved rapidly in general health, appearing finally well. Nasal respiration was free upon both sides, notwithstanding the deflected septum.

March 15th, 1904, there developed slight difficulty in breathing upon the left side of the nose An examination revealed a small growth about the size and shape of a shelled almond situated upon the left side of the septum high up and in its anterior portion. There also developed about the same time metastatic growths upon both legs. On the right, there was one on the anterior and external surface below the knee, one on the anterior internal surface in the lower third of the leg and two in the middle of the calf. On the left leg. there was one in the middle of the calf. These growths were purple in color, smooth, shiny, firm and round. From March 15th until May 25th, X-ray treatment by Dr. Stover was conscientiously carried out, but resulted in no apparent improvement. The almond-shaped growth in the nose was then removed by scissors and knife and its surface thoroughly cauterized with the galvano-cautery, which procedure was repeated June 8th.

The secondary growth was again referred to Dr. Mitchell, who reported as follows:

"In reference to this examination of the nasal tumor of Mrs. C., I have to report the structure shows the identical cellular elements as the first mass, with the exception of numerous blood vessels. No signs of breaking down." (See Fig. 2.)

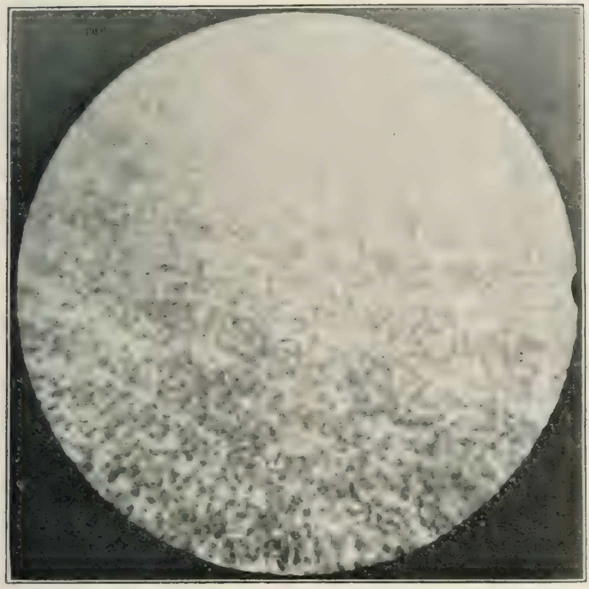

Fig. 2.

The nasal symptoms now continued to increase in severity, the stenosis became more marked and the nose swelled appreciably. Despairing of accomplishing anything further, the doctor was advised to make his mother as comfortable as possible and patiently await the final, fatal termination.

The patient was not again seen by me until April 12th, 1905, almost a year after the last operation. At this time the following remarkable condition was found: Absolute and complete disappearance of all evidence of nasal trouble, free breathing and no sign of a growth. A cicatrix was seen in the left nasal cavity at the site of former cauterizations, and a synechia extended from the septum to the roof of the nose. All but two of the growths upon the legs had disappeared, leaving a shiny, brownish discoloration. The two remaining were on each calf and were growing steadily, the one on the left calf measuring two inches and the one on the right one and one-half inches in diameter. In addition to this a small nodule had made its appearance upon the inner surface of the right leg, somewhat below the middle. This nodule was about the size of a small almond, the skin over it being as yet not discolored. Upon inquiry it was found that the patient had received absolutely no medical attention. The disappearance of the growths had been entirely spontaneous. The diagnosis was now seriously questioned. Having learned several weeks before this examination of the progress the patient was making, a critical investigation into the diagnosis was instituted. The specimens were sent to Professor Welch at Johns Hopkins, whose report in full is here appended:

"JOHNS HOPKINS UNIVERSITY,

Baltimore, March 13th, 1905.

"Examination of specimens from nose for Dr. Robert Levy.

The specimen consists of several good-sized pieces of solid tissue, two or more centimetres in diameter, of irregular shape, but often uniform. The microscopic sections show in places over the rounded surface epithelium, partly cylindrical and ciliated, partly squamous, like that of the nasal mucous membrane, but more commonly this free surface is ulcerated and presents a necrotic, fibrinoid aspect.

The rest of the sections consist entirely of tumor, which is composed almost wholly of cells with scanty basement substance.

The cells are of the type of those of a small or medium-sized, round-celled sarcoma. Their nuclei are round or slightly oval, with distinct nuclear membrane and one or more nucleoli, or nucleolar-like bodies. Broken bits of chromatin or an imperfect chromatin-reticulum are present within the nuclear membrane. The protoplasm around these nuclei is in general so friable that it is recognizable with difficulty or not at all in most places, so that the nuclei appear naked, as is so often the case in sarcomata preserved in alcohol. Where the cell-body can be seen, the cells appear to be round, oval or irregular, sometimes angular in shape and are not very large. These cells, which constitute the great mass of the tumor, are crowded together without any definite arrangement or architecture. There is a scanty fibrillar or reticular intercellular substance which belongs to narrow fusiform cells of a fibroblastic type. These latter cells and fibrils make up the delicate supporting framework of the masses of round cells composing the tumor.

Blood vessels are seen in fair number. These, even when of large size, have thin walls which are immediately enveloped by the tumor cells. Some of the superficial veins contain fibrinous thrombi.

In some sections there is a layer of connective tissue between the covering epithelium and the tumor; in others, the tumor reaches the free surface of the sections.

Diagnosis.—Small, round-celled sarcoma.

Remarks.—The tumor probably originated in the lymphatic tissue of the nasal mucous membrane. It might also be designated a lymphosarcoma, but this term has been used in so many different senses, that the application is frequently misleading. The present tumor has not the features of Hodgkin's disease, but resembles certain true sarcomata of lymphatic glands. It has the histologic features of a rapidly growing, true, round-celled sarcoma, such as can originate not only in lymphatic tissue, but in any connective tissue of the body, and is likely to produce metastases.

The fact that the tumors ceased to grow and eventually disappeared, is interesting and remarkable. There is nothing in the sections to point to syphilis as a cause of the tumors. Similar tumors have been known to disappear, but I have no explanation to offer. Evidences of any regressive metamorphosis are not seen in the sections.

WILLIAM H. WELCH."

(See Fig. 3.)

Professor Welch made the following personal communication:

"March 13th, 1905.

"My Dear Doctor Levy:

"I should regard the tumor as true round-celled sarcoma and malignant, indeed, as belonging to the type of the more malignant sarcoma; more malignant, for example, than the so-called spindle-celled sarcomata. But I know from experience that it is unsafe to make as positive a statement about the clinical course of sarcomata as about carcinoma, and cases apparently alike may pursue quite different courses.

The fact that tumors with every microscopic appearance of malignant growths may spontaneously disappear is known, but it is so rare and the conditions for such disappearance so

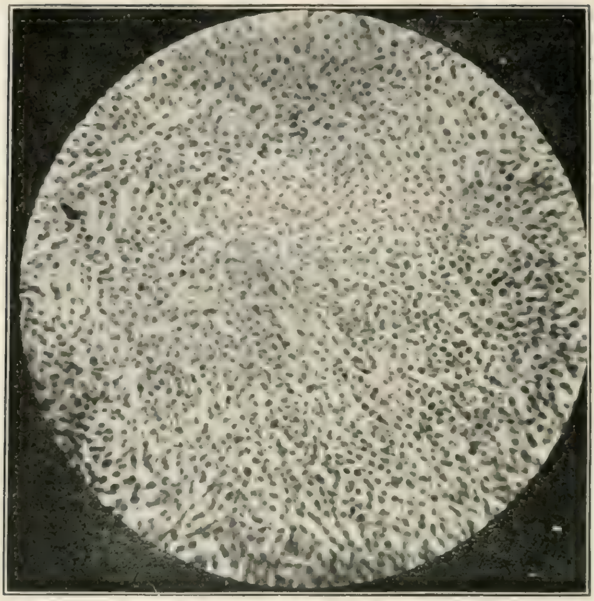

Fig. 3.

unknown, that such an observation as yours should be reported with the microscopic findings. This occurrence is more common with sarcomata of this general type than with other forms of tumor. Very sincerely yours,

WILLIAM H. WELCH."

Under date of October 9th, 1905, in complying with my request for a statement as to his mother, Dr. C. replied "that there are no signs of anything in the nose, but that the growths on her legs have grown quite rapidly, and that one of them is discharging freely. She is now hardly able to walk and is failing rapidly." The return of these growths on the legs began about May, 1905, multiplying rapidly until twenty-five or thirty about the size of walnuts were found between the knee and ankle. About July 1st, 1905, these began to ulcerate. The patient was confined to her bed about January 1st, 1906, and died March 3rd of exhaustion.

A post-mortem examination of the legs was made by Dr.

Harding of the pathologic laboratory of the Denver and Gross College of Medicine.

He reported as follows: Right leg, one round nodule three inches in diameter, raised, hard, nonulcerated over the inner side of the calf. Left leg, a line of seven nodules on the crest of the tibia extending from the tubercle to the malleoli. These were firm, nonulcerated and not movable over the bone. Ten similar nodules were scattered over the outer side. One nodule was situated over the inner head of the gastrocnemius, and over the inner side a firm blue ulcerated mass three inches wide extended from two inches below the tubercle of the tibia to the internal malleolus. Microscopic examination of sections from a number of these nodules showed small, round-celled sarcoma. (See Fig. 4.)

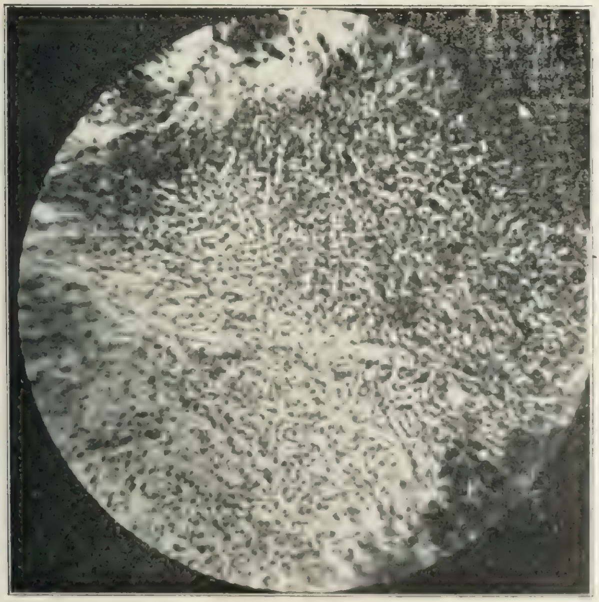

Fig. 4.

The interest attached to the spontaneous disappearance of malignant growths becomes more intense as authentic cases in the literature multiply. The above case is presented in full detail, as every case should be which deals with a question of such great importance and one which may be subject to much doubt and criticism. From the evidence, however, in the above report, we must conclude:

First.—That so far as our pathology can determine, the case was one of undoubted malignant growth.

Second.—That the nasal tumor completely and spontaneously disappeared.

Third.—That several metastatic growths completely and spontaneoulsy disappeared.

Fourth.—That several metastatic growths markedly retrogressed.

A careful search through the literature reveals reports of disappearing tumors of various characters. Those presenting characteristics of malignant growths are not numerous, and particularly do we find the clinical diagnosis of malignant tumors without a convincing histologic report. That the clinical evidence should not be considered as proof positive is admitted by all, but on the other hand the microscopic diagnosis may also be open to question. Commenting upon the cases of Senger, reported later, in which tumors exhibiting all the microscopic appearance of cancer disappeared, Freeman (1) states that Senger "agrees with Gussenbauer that they were probably not true sarcomata, the clinical evidence being perhaps more trustworthy than the microscopic in such cases."

It is, therefore, contended:

First, that clinical and microscopic evidences should agree and be indisputable, and

Second, that one may accept the diagnosis of either clinician or pathologist, providing these are of recognized ability and authority.

CASES RECORDED.

J. Gregg Smith (2) reports three cases.

1. Patient, male 25 years. Sent to hospital June 1st, 1889. Intestinal obstruction. Solid tumor as large as cocoanut occupying left iliac region. Intestines adherent to it. Sarcoma was diagnosed. Intestinal evacuation and drainage. Enterostomy in lower ileum. Feces passed through artificial openings for two weeks, then began to appear per rectum. At end of six months artificial opening was closed. No tumor

could be felt through the parietes, and at time of operation the finger in incision felt only adhesions. Patient recovered, and after four and one-half years is well.

2. Widow, aged 50. October 26, 1889, after gradually increasing weakness for some time, had first noticed swelling in abdomen (umbilical region), adherent to skin and movable with parieties. November 8th operation. Two drachms of muco-pus lying under skin of umbilicus was evacuated. No sinus discovered. Tumor explored, and by reason of adhesions removal was not attempted. Growth believed to be cancerous, and hopeless prognosis given. Gradual loss of strength and flesh, sallow complexion, no pain, no elevation of temperature. Patient, however, began to improve. A sinus discharged pus for a year, ceased six months and then returned. Healed finally. Patient seems entirely recovered.

3. Nursemaid, 19 years. Entered hospital January 9th, 1892, complaining of general weakness for six months past. Had noticed swelling on right side of abdomen which gradually increased in size. Tumor solid and size of eight months pregnant uterus. January 11th growth exposed by incision four inches in length. Adhesions between growth and parietes separated. All present believed growth malignant, and as it adhered behind and at the top under the ribs and with unmovable organs, operation was abandoned. January 19th wound began to gape, and soon a fecal fistula formed, through which for three months all the feces passed, while the tumor gradually decreased. May 1st opening closed. May 6th wound was found quite healed. June 21st patient entirely well and has so continued.

Remarks.—The author by a process of elimination concludes that all three of these cases were malignant growths which spontaneously disappeared. The only authority for his diagnosis was the clinical appearance, the fact that upon section of Case 2 the mass presented a gray, glistening appearance similar to that of sarcoma, and the opinon of others present at the operation.

Barker (3) reports a case of tumor which he believes to have been sarcoma situated under the angle of the right jaw. Upon operation tumor was so firmly attached to the transverse process of the vertebra that the operation was abandoned. Four years later the entire growth had disappeared.

G. M. Smith (4), after speaking of the very few reports and the difficulty of making an exact diagnosis, reports the following case:

W. R. C., aged 52, gardener. Admitted to hospital in March, 1894. First noticed swelling at angle of right jaw in May. No syphilis, tuberculosis or former lesion. Growth was removed and found to be encapsulated, but firmly attached to masseter and other structures, two inches by one in diameter. Microscopically small round cells were the chief constituent, and there was little stroma. Wound healed.

In August, 1895, readmitted, because of smooth, firm lobulated swelling involving parts behind and beneath the angle of jaw (right side) and extending downward anteriorly to the sternomastoid. Slight pain. Considered a recurrence, and operation decided upon. Growth similar to former, but extended deeply into the neck and was adherent to the prevertebral muscles. It was found impossible to remove tumor. Wound plugged with gauze. Wound healed by granulation in three weeks. Patient left hospital for two or three weeks. On his return tumor had decreased in size. Four and one-half months after operation there appeared no trace of the swelling, but there was a small, hard gland on opposite side of neck.

In February, 1896, a circular ulcer appeared upon fauces and right tonsil.

Treatment.—Iodid of potassium, which was of little avail. However, under no special treatment but rest in bed and antiseptic washes, the malignant looking ulcer disappeared.

In July, 1896, patient was suffering with "round lump just beneath his left ear, firm, pigmented and increasing in size." Abdominal walls were tense from the presence of ascites. Edema of limbs and scrotum. Several subcutaneous nodules on arms and legs. Diagnosis of malignant growth made and the case seemed hopeless. In seven weeks' time edema began to disappear and gradually left an apparently healthy abdomen. Meanwhile, lump on neck began to increase, and in December it was as large as an orange, fungating, soft and dark reddisn. Frequently bled from the foul cauliflower-like excrecences with which it was covered. Removal of this large superficial tumor. Its base was indurated and the deep structures of neck were involved. No attempt made to remove this. "Some attempts at healing took place." However, in groins, forearms and legs, several lumps were present which presented all the appearances of sarcomatous deposits. Microscopic examination showed small, round cells with numerous blood vessels and very little stroma. The subcutaneous nodules rapidly developed in size and number. Death. No post-mortem.

Remarks.—The author believed that the primary lesion was a lymphosarcoma at the angle of the jaw. After extirpation, it recurred, and after unsuccessful attempt at removal spontaneously disappeared. The ulcer on tonsil and the ascites seemed clearly malignant, yet recovery was made from both. Author, therefore, has the belief that from the microscopic examination, the clinical features and the termination by numerous pigmented tumors is strong evidence in favor of "the whole cycle of events being malignant."

Dwight (5) reports an apparently benign tumor which disappeared, but mentions two cases of Sir James Paget. One multiple medullary sarcoma occurring on the neck and in the axilla. A large mass over one deltoid suppurated and sloughed, during which process the other growths disappeared. The man recovered and enjoyed good health for some time, but recurrence took place and the patient died. The other, medullary cancer of an undescended testis. The tumor was very large and disappeared. Recurred four times before death resulted. Both cases were confirmed microscopically.

Bennett (6) relates the following nine cases:

1. Female, aged 36. Tumor in abdomen, right side, immediately below liver. Mass gradually increased. Emaciation and cachexia. Abdomen opened and liver and omentum appeared to be involved. A portion was excised for microscopic examination and subsequently reported to be a typical specimen of mixed and spindle-celled sarcoma. No removal save as stated above, and prognosis considered grave. In eighteen months, however, tumor had vanished and patient was healthy.

2. Female, aged 52 years. Melanotic sarcoma of the sole of the foot which was excised. A few months later recurrence and amputation. Two months later small blackish tumors appeared on thighs and increased to the number of sixty-two. Microscopic examination showed them to be typical "round-celled sarcoma without pigment." Consultation was held and no operation was decided upon. Six months later she presented but three nodules and later was entirely healthy.

3. Another case almost identical with No. 2.

4. Male, 48 years. A tumor thought to be a hydrocele had existed for nine years and unchanged in size for seven. Trocar inserted without result. Later, by means of a large trocar and canula, some tissue was secured for examination. Diagnosis was sarcoma, confirmed by microscope. Castration postponed and within six months growth had disappeared.

5. Another case identical with No. 4, except that diagnosis was not confirmed by microscopic examination.

6. In this and the following case, the diagnosis was made from clinical characteristics. Patient middle-aged man. Emaciation and cachectic appearance. Abdominal section showed orange sized mass involving pylorus, together with nodules in omentum and around liver. Gastrojejunostomy performed. Rapid recovery from operation, and tumor after five years is imperceptible.

7. Female, of middle age. Large tumor in lower part of neck. Sallow. Below the tumor on right side was a large glandular mass. Operation believed not to be justified, but all physicians who made examination thought tumor malignant. A few months later mass began to shrink and finally disappeared with consequent restoration of health.

8. In this case an encephaloid carcinoma was removed from the testicle of a man 40 years of age. This was followed by a tumor being found near liver. Patient's condition grew gradually worse and fatal termination was thought inevitable. Disappearance within six months and restoration to health.

9. Unmarried woman, 36 years of age, with scirrhous carcinoma of left mamma. Removal three years later, seemed to be involvement of right breast and consequent removal. Soon after second operation, hard nodules appeared along scar of first operation wound, followed by others in the skin, which appeared typical. She paid no attention to these, and seems now healthy.

Remarks.—Of these nine cases, Cases 6 and 7 are open to question. The clinical characteristics were, however, distinctly conclusive.

D'Arcy Powers (7) reports five vanishing tumors, three of which he believes to have been malignant.

1. Male, 21 years. Tumor situated between umbilicus and

pubes, size of a cocoanut. Could be felt per rectum. Incision was made through the lienea alba, but tumor was too firmly attached to be removed. Incision was closed and patient left hospital with no noticeable decrease in its size. Three months later tumor had entirely disappeared.

Author believes tumor to have been sarcomatous, basing belief on rapid growth, firm connection with pelvic bones, progressive loss of weight and appearance of tumor at the exploratory incision.

2. Male, 54 years. Emaciation. Tumor in abdomen just below liver. Exploratory incision showed that on account of adhesions, growth could not be removed. Four months later, tumor had disappeared. Several months later, however, he died from jaundice, and autopsy showed malignant growth at head of pancreas.

3. Patient, 24 years. Following blow on head, tumor developed, subsequently followed by six or eight others in different parts of head. Still another developed, which was removed. Microscopic examination showed it to be a fibrosarcoma. The others disappeared spontaneously, but patient nevertheless succumbed.

In summing up, the author states: "In a cancer, such a disappearance (spontaneous) seems to be quite inconceivable, unless we assume the disease to be one of an infective character, in which the result as measured by the growth, is in direct proportion to the amount of poison absorbed or manufactured within a body which is more or less predisposed to its action."

D'Aguanno (8) discusses the question of the disappearance of malignant tumors, and refers to the fact that Ziegler believes this impossible and that the disappearance is only temporary, resulting in later new development. Their partial disappearance is, however, observed. He relates the case of a boy aged 13, where a malignant tumor disappeared. The author's conclusions are as follows:

"1. The reduction or spontaneous disappearance of growth may occur with regard to tumors of the pharynx and nasopharyngeal space as elsewhere.

2. This retrogressive feature takes place not only in cases of benign tumors, or for adenoid vegetations where it is the rule, but also in case of tumors of malignant nature whether

they take their origin in the conective tissue or originate in the epithelial tissues.

3. This retrogressive process occurs most often (outside of the cases of parasitic infection) through alterations of the stroma of the vascular walls of the tumor and their contents.

Plenio (9) reports the case of a patient 22 years of age, famale. Hereditary antecedents negative. Two years before had noticed a "thickness" under the skin over the right gluteal muscle which had during the last eight months spread to the inguinal region. Tumors increased in size rapidly. In September, 1883, patient was brought to hospital and physical examination showed well-nourished, well-built woman; there was an enormous tumor over the right gluteal muscles; the skin could not be moved over the mass easily and in the center was colored blue. Tumor was of very hard consistency. Measurements were from the spine to the os sacrum 39 cm., oppositely 26 cm. Another tumor of hard consistency was found in the inguinal region. Diagnosis was made of sarcoma. On following day the small tumor was removed, but it appeared impossible to remove the larger growth entire, though some adhesions were broken up and a part removed. Prognosis was given as very grave. Preparations of salicylic acid were used. (Microscopic examination of the excised part of tumor showed it to be a melanosarcoma.) Patient contracted pneumonia, and as this disease left her the tumor gradually decreased in size. December 6th there was but an "infiltration palpable." During the year 1884 the growth entirely disappeared, appetite returned and general state of health was normal. In 1885 patient was again seen; was eight months pregnant, and in perfect health.

Warthin and Spitsley (10) have related a number of vanishing tumors of non-malignant character reaching the following conclusions:

First.—That in spite of skillful clinical observation, the ultimate behavior of a tumor is seldom to be determined except by microscopic examination, and that many seeming malignant neoplasms are taken to be such when really they are but the outcome of an inflammatory condition.

Second.—That probably no true neoplasm, malignant in nature, ever disappeared except through retrograde changes induced into itself through infection of the tumor tissue, or through affections or infections of other parts of the body having, by reason of toxins, practically the same effect. To this there are extremely rare exceptions in which the disappearance of the growth takes place by an egress or by retrograde processes over those of growth.

Third.—We must look to the inflammatory process, acute or chronic, for the explanation of the appearance or disappearance of these masses of tissue, which before and even during exploration appear to be actual new growths.

Watson (11) relates the following: Patient, a woman aged 36, presented a large pendulous tumor attached to left side of the back; growth presented the appearance of a lipoma undergoing degeneration. Growth was removed and several independent microscopic examinations showed it to be a mixed round and spindle-cell sarcoma. A week after operation, wound ulcerated and tumor rapidly reappeared, quickly reaching to former size. The growth was so extensive that its thorough removal was considered impossible. After a time the tumor began to decrease and gradually shrank, and the wound entirely cicatrized. One year after operation, the patient was in excellent health, the tumor was less prominent and hung as a loose sack of skin. Except for the ulceration, no inflammatory phenomena presented themselves locally after the operation.

Remarks.—The fact that ulceration occurred and was accompanied by fever offers an explanation of the disappearance of the sarcoma in this case. The author quotes Wyeth as having pointed out the value of infection as a cure in sarcoma.

Randolph (12) presents a patient, male, aged 43. Three years before, there appeared on the posterior aspect of the left forearm, about the junction of the upper and middle thirds, a small nodule beneath the skin, which was movable and painless. The mass grew for six months, remained stationary then until two weeks before operation, when it exhibited signs of inflammatory reaction. The mass was excised and two weeks later the wound had healed by primary union. There is no evidence of recurrence.

Pathologic Report.—The mass is flattened, slightly elliptical, 1½x2¾ inches. It has no capsule but has an envelope which is derived from the surrounding connective tissue. On section it presents a grayish white appearance, composed of dry friable fibrous material.

His conclusions are:

First—That a sarcomatous growth started in the subcutaneous connective tissue.

Second—That it grew steadily for six months and then for some unknown reason became arrested.

Third—That a necrosis or atrophy of the cells of the tumor took place.

Fourth—That later the inactive tissue began to act as an irritant and the response was productive of inflammatory process which endeavored to remove a foreign body.

Fifth—The very abundant presence and peculiar change of the giant cells seem to show that the function of these cells is an absorptive one. In the discussion Dr. Stengel said that he had under observation a patient with multiple sarcoma in which the tumor at times disappeared. It was, he said, difficult to understand the disappearance of carcinoma, sarcoma and tuberculous growths.

Dr. Leonard Freeman (13) makes the statement that fibrous cancers of the breast occasionally undergo spontaneous cure, especially in old women, and quotes Billroth and Kaposi (14), who assert that superficial epitheliomata of the skin sometimes heal without treatment. He relates Stoerck's case of epithelioma of the tonsil which disappeared without interference, but in which recurrence took place in one year. He also records the following case:

A man, aged 38, giving no history of syphilis, developed a small, superficial, indurated sore, on the right half of the lower lip at the mucocutaneous junction. After partially disappearing and again enlarging, the ulcer finally disappeared, leaving a slight scar. Less than a year afterwards and nearly two years from the beginning of the disease on the lip, a swelling was noticed in the right submaxillary region. Nine or ten months later this was removed. Local recurrence took place within three weeks. After another operation the growth was temporarily checked, recurring, however, and destroying the patient. Microscopic examination of the tumor in the neck showed typical epithelioma.

Freeman concludes that although microscopic evidence of the cancerous nature of the original ulcer of the lip was wanting, circumstantial evidence, presumably the development of a secondary malignant growth, was so strong as to admit of no reasonable doubt.

Gaylord and Clowes (15) have found, in addition to the above cases, the following:

Senger (16). Epithelioma of the tongue with complete disappearance, leaving nothing but a scar in the mucosa. No recurrence one year later.

Crosbie (17). Cancer of the lip in which the diagnosis of malignancy was confirmed by pathologic examination. After a small portion was removed by scissors the remaining disappeared entirely.

Gould (18). A woman presented a typical scirrhous cancer of the breast, which was removed, and upon microscopic examination the diagnosis was confirmed. Later, recurring nodules were found around the scar. She was considered inoperable and although symptoms of metastatic growths elsewhere developed to a considerable extent, these all finally disappeared. The patient gained flesh and returned to apparent health. The skin nodules as well as an enlarged gland in the axilla and neck all disappeared.

Rotter (19). A case of malignant adenoma of the rectum followed by spontaneous healing. Diagnosis was confirmed by microscopic examination by Orth. Rectum was extirpated, recurrence took place, the diagnosis of which was again confirmed by the microscope. There were numerous curettings, each, however, followed by such rapid recurrence that the patient was finally discharged incurable April 18, 1896. In July, 1896, Rotter again examined the case and was surprised to find all evidence of tumor absent, the growth having apparently completely disappeared. Death occurred three years later from metastasis.

Tripier (20) reports two cases of sarcoma, the diagnosis of one being doubtful. The other was a case of numerous nodules in theepitrocllear and epicondylian region of both limbs with numerous nodules elsewhere. Microscopic examination of one nodule was positive. At last examination, six years later, the patient was in apparently good health, tumors having completely disappeared.

Hormann (21). Chorion carcinoma of the uterus with metastatis in the vaginal wall. Microscopic diagnosis was made by Albrecht. Numerous curettings were done but no radical operation. The patient became pregnant and was delivered at term followed by normal return of menses. Three years after first examination all evidence of tumor had disappeared, patient being in apparent good health.

Noble (22). Chorion carcinoma with partial removal through hysterectomy. Sixteen months after operation patient presented every appearance of good health and careful examination failed to show any evidence of tumor. Diagnosis in this case was confirmed by the microscope.

Littauer (23). Soft nodule in the uterus. Scrapings showed epithelial proliferation. No operation was performed. Examinations of scrapings of second curetting was negative. One year after curettage, patient was entirely well.

Fleishmann (24). Nodule on vaginal wall and enlarged uterus. Nodule was removed and uterus curetted. Microscopic diagnosis was chorion cancer. Ten months later, no evidence of tumor could be detected.

Von Franque (25). Case of chorion cancer. Diagnosis confirmed by microscope. Uterus curetted, followed by restoration to complete health.

Langhans (26). Vaginal nodule, recurrence after removal. Nodule finally broke down and healed spontaneously. Microscopic examination positive. Complete recovery ten months later.

In view of the authentic cases reported above and of the animal experiments beginning with those of Wehr in 1883, down to those of Gaylord and Clowes, it must be conceded that undoubted cases of malignant growths disappear spontaneously.

As to the nature of the process involved, the peculiarities or causes for the same, we must turn to further investigations of the pathologist. The clinician can only report clinical facts, but it is to the laboratory that we must look for causes.

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LIX.

MIDDLE EAR SUPPURATION AS AN ETIOLOGIC FACTOR IN RETROPHARYNGEAL ABSCESS.

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The frequency with which suppurative processes in the middle ear extend into the mastoid cells, and occasionally from these into the cranial cavity above and the digastric fossa below, is generally well known. Judging by experience, and a study of the literature, the invasion forward into the pharyngeal structures is exceedingly rare. Indeed, retropharyngeal abscess in the adult from any cause is a rare condition.

The formation of pus with the accompanying changes in the mucous membranes of the mastoid cells, causes pressure upon and a general stasis within the vessels nourishing both the mucous membranes and the bony framework of the whole mastoid area. The only natural drain of the mastoid cells is the aditus, which is situated at the top of the cavities when the head is near the upright or horizontal position, and at the best is small, and offers a poor channel for the discharge of thick pus. The maintenance of a free circulation is an important factor in the prevention of a destructive process, as well as in the repair of an injured tissue. For this reason all suppurative processes are given early surgical treatment.

It is evident that in the structures behind the ear we have favorable conditions for a destructive process whenever there is septic invasion, and the reason why the destructive processes so rarely advance forward, is likely that the Eustachian tube and pocket which lodge the tensor tympani muscle give free drainage, which not only liberates the irritating secretions, but avoids pressure upon the local circulation. We can understand how through adhesions and the formation of granulation and polypoid tissue, or other new growth, the drainage of the anterior portion of the middle ear can be interfered with, or entirely blocked.

If there is a suppurative process under these conditions, the Eustachian tube, if patent, may care for the secretions, and thus extensive disease be avoided. When, however, the tube also becomes obliterated, there is no reason why the suppuration should not advance, here producing necrosis of surrounding tissue, as it does in other localities; and this is probably what does take place in the few cases which advance and form abscess cavities behind and about the pharngeal wall.

Even where there is a blocked Eustachian tube and tissue within the middle ear retarding the drainage of pus, the diseased area is so small that only a small amount of secretion would be likely to form, and that so slowly, that only rarely would it produce much pressure.

While it is evident that we have in the tissue behind the ear most favorable conditions for the advance of a suppurative process, there is only very rarely present the conditions necessary for the advance forward of such a process.

In the second century, Galen referred to a case of retropharyngeal abscess. So far as I can learn, one of the earliest reports of cases was by Abercrombie (1), who in 1819 described three cases as observed in children. In 1850, Fleming (2) reported two cases. Henoch during 1850 and 1851 (3) published a report of cases. The elder Bokai (4) in three different papers reported, in all, 129 cases. They were all observed at the Children's Hospital at Pest between 1854 and 1876. His son (5) took up the work and reported 138 cases of his own. There are a large number of writers who have reported one or more cases, but when we search for reports of retropharyngeal abscess in the adult, we are impressed by the comparatively few cases which have been recorded.

As it is not my purpose to discuss the general subject of retropharyngeal abscess, I shall mention only those cases reported as occurring in the adult, as both cases which I report in this paper were in adults and of aural origin.

In a paper presented by Watson (6) in 1903, he reported one case occurring in an adult. He was able to find only 16 other cases reported. Among these were the cases of Gunther, Heald, Syme, Goodale, Bosworth, McCoy, Moore, Lennox-Browne, Fischer, Dunn and Shirley. Besides these I have been able to find the case of a man 46 years of age reported by Levestine (7), one of an adult by Petrunti, one by Downie (8). of a woman 79 years of age, one by Cheyne (9) in an adult 42 years of age, one by De Blois (10) of a man 27 years of age, one by Berg (11) in an adult, supposed to of tubercular origin, and one by Allen (12) in a man 38 years of age. Lennox-Brown says that in his clinics he sees twice as many cases in adults as children, but he gives no statistics.

Both Bokai, senior and junior, mention the ear when speaking of etiology, but they included no such cases in their statistics, nor did they report the aural conditions existing in their reported cases. Huber (14), in reporting cases, mentions one which ruptured into, and discharged from, the external ear.

Oppenheimer (15) in his paper upon the etiology of retropharyngeal abscess, speaks of the possibility of the retropharyngeal glands becoming infected from a suppurative process in the middle ear.

Klug (16) reported a case of aural origin, with erosion of the carotid artery. Urbano Melzi reported a case of a child 2 years of age, who had a retropharyngeal abscess which he considered of aural origin.

Weil (17) states that suppuration of the tympanic cavity in children is not an infrequent cause of retropharyngeal abscess. He also reports a case of a child who died, where the post-mortem showed extension from ear into retropharyngeal abscess.

In reply to 250 cards of inquiry, addressed to ear, nose and throat surgeons, 147 reported as never having seen a case of retropharyngeal abscess due to middle ear suppuration, ten reported as having seen one or more cases.

Hoping that the discussion of this paper will be taken up by many of the gentlemen who have so kindly submitted their reports, and that then we can find there are sufficient facts to prove beyond reasonable doubt that all belong in these statistics, I submit them as they were presented to me.

Dr. Chevalier Jackson reported as follows: "My notes on retropharyngeal abscess are imperfect, but as I have thought for many years that the frequency of otitis media as the primary pus focus is overlooked, I have rather full notes of twelve cases associated with (and probably secondary to) purulent otitis media. In six of the cases, ear trouble had not been noticed until I searched for it; in four cases it had been noticed, but was not considered of consequence; in only two was its true etiologic significance recognized. In four of the six unrecognized cases, no discharge was escaping from the canal, the drum membrane being healed or unperforated. In three of the cases, the otitis media might be called chronic; nine were acute. The primary diseases which preceded the otitis were: scarlatina, four; measles, two, diphtheria, two; influenza, two; rhinitis, one; unknown, one. Three showed evidence of hereditary syphilis.

The pus organisms found in the pus of the abscesses were:

Streptococcus, pure	4
Staphylococcus, "	1
Streptococcus Staphylococcus } mixed	2
Pneumococcus	1
Not examined	4

(Approximately)

Ages: Two years.
Three "
Four "
Two "
Two "
One "
Ten months,
Fifteen "
Six "
Two "
Two "
Fourteen "

Average about eighteen months.

Sex: Eight were females, four males.

One abscess burst spontaneously before my arrival; one burst during digital examination; one asphyxiated the patient before my arrival; nine were incised. Two were tracheotomized, one for a complicating perichondritis, and one because breathing had stopped during digital examination. Both of these cases recovered. Of the twelve cases, two died, one of asphyxia before my arrival and one of sepsis."

Dr. A. E. Crockett has seen five cases, one of which was reported a year ago in a paper on "Thrombosis of Sinus and Jugular."

Dr. Robert E. Moss has seen three cases, two males, 40 and 65 years of age; one female, 26 years. Both men had mastoid operations.

Dr. F. B. Sprague saw a woman 30 years of age in Politzer's clinic, who had retropharyngeal abscess due to ear extension. He is also treating a man 30 years old for the same condition.

Dr. J. J. Thomas operated on a girl of 7 years of age in whom a middle ear suppuration had extended into nasopharynx. Perfect recovery after incision.

Dr. S. H. Lutz reports case of female, 2 years old. He incised abscess and child left hospital in five or six days.

Dr. D. C. Green, Jr., operated on girl 3½ years old for retropharyngeal abscess, which was undoubtedly due to middle ear inflammation.

Dr. E. W. Day saw a man 18 years of age who had middle ear suppuration since childhood. Patient was in dying condition when first seen, and as there seemed to be obstruction to breathing, a digital examination of throat was made, and a large retropharyngeal abscess found. Opened with finger. Patient died, although no pus entered larynx.

Dr. J. A. Stucky has seen a 3-year-old girl who had retropharyngeal abscess due to an acute middle ear suppuration. Opened with finger. Child made perfect recovery.

Dr. Thomas Hubbard reports the following case: A man, 55 years of agee. O. M. P. A. Neglected. Mastoid suppuration. Bezold perforation. Pus burrowed toward pharynx and discharged spontaneously. No operation other than incison over mastoid allowed. Patient died from exhaustion and general septicemia.

In making a diagnosis, we have the same conditions to differentiate as with retropharyngeal abscess from any other cause. Perhaps the most important thing to eliminate is aneurism. Fortunately, the condition is very rare, comes on slowly, without the septic symptoms, and usually shows more swelling and bulging of tonsil and soft palate. The pillars of the pharynx are usually carried forward and inward to a more marked degree than in retropharyngeal abscess.

A marked, deep, cervical cellulitis, a new growth, or an injected and swollen gland might be mistaken for a collection of pus. In these conditions we would get no fluctuation.

Whenever we find a retropharyngeal abscess with the history of a chronic discharging ear on the same side, we should at least consider the ear condition as a possible etiologic factor. If possible, a probe should be passed, and the anterior portion of the middle ear explored. In the second case I report, the probe not only detected bare bone but was pressed forward into a cavity, and upon removal considerable pus escaped.

Although we are all familiar with the general anatomy of the pharynx, of the anterior wall of the middle ear, and of the superficial relations of the triangles in the neck, there may be some doubt of the relations between these areas. I found when operating upon the first case, that I was not quite sure about how many important structures might be located between these areas. The large vessels could be distinctly felt by the finger, but the nerves could not be thus located, and I was afraid I might wound or destroy one or more of these.

In reviewing the anatomy of this area I will, for convenience, begin with the pharyngeal wall, a region with which we are all familiar. Here just below the mucous membrane are the three pharyngeal constrictors, with their aponeuroses forming the walls of the pharyngeal tube. These muscles are so arranged that the superior is overlapped by the middle, and the middle by the inferior. This muscular tube is attached above to the pharyngeal spine of the basilar process of the occipital bone, the posterior portion of the mylohyoid ridge of the inferior maxilla, the side of the base of the tongue, the pterygomaxillary ligament, the lower third of the posterior border of the internal pterygoid plate, and the hamular process of that plate. Below it is attached to the posterior part of the side of the cricoid cartilage behind the cricothyroid muscle, to the inferior cornu, the oblique line and the superior border of the alae of the thyroid cartilage. It also attaches to the stylohyoid ligament, the little horn and the whole upper surface of the great horn of the hyoid bone. Directly behind this muscular tube are the anterior vertebral muscles and the lymphatic glands, but at either side is an area somewhat prismatic in shape which is of much interest to our present study. Above is the lower surface of the posterior portion of the temporal bone, the fibrous floor of the Eustachian tube and a small posterior portion of the great wing of the sphenoid bone. Through this bony superior boundary pass the internal carotid artery, the internal jugular vein, the middle meningeal artery and the pneumogastric, glossopharyngeal, hypoglossal and inferior maxillary nerves. The anterior and outer boundary is made by the ramus of the inferior maxilla and the outer pterygoid plate. Posteriorly, the bony landmark is the styloid process of the temporal bone. There is no fixed lower boundary to this space, and pus can dissect as far as and into the mediastinum. The internal pterygoid muscle occupies much of the antero-external space. Between this muscle and the ramus of the inferior maxilla are the internal maxillary artery and the dental nerves and vessels. There is considerable cellular tissue between the anterior portion of this muscle and the superior constrictor of the pharynx. This cellular tissue offers less resistance to dissecting pus, and here we would expect to find its first appearance when coming from the anterior portion of the tympanum.

A cross section at about the level of the tip of the mastoid shows the following relations: Near the median line the pharyngeal muscles are in contact with the prevertebral muscles. Only a few lymphatics are between them. We find that the pharyngeal tube curves forward, and at either side is an area, somewhat triangular in shape when thus viewed, in which are situated the following structures:

Posteriorly is the internal jugular vein, just at the inside of this is the pneumogastric nerve, slightly anteriorly and internally is the internal carotid artery. These are surrounded by firm fibrous tissue. To the outside and just in front of the internal jugular vein is the tip of the styloid process, and the beginning of the styloglossus, stylopharyngeus and stylohyoid muscles. In front of this is usually found a portion of the parotid gland, which dips deeply into the neck at this area. A short distance in front and to outside of the internal carotid artery is the external carotid artery. In this locality is also situated the hypoglossal and glossopharyngeal nerves. Between these structures and the pharyngeal muscles is an area of loose connective tissue, in which are a number of veins. At the level of the vault of the pharynx, which is also the level of the bony wall of the Eustachian tube and that of the bone liable to be attacked in extension of middle ear disease, we also find situated, just in front and to outside of this triangular space, the inferior maxillary division of the fifth nerve, the middle and small meningeal arteries, the auriculotemporal nerve and its two roots about the meningeal artery and some of the branches of the internal maxillary artery. It is important to remember the relation of the pneumogastric, the glossopharyngeal and the hypoglossal nerves.

The pneumogastric nerve is to outside of the internal carotid artery and between this and the internal jugular vein. It is in a common sheath with these vessels, and is not liable to injury. The glossopharyngeal nerve leaves the cranial cavity through the jugular foramen. It passes obliquely downward and forward, between the internal jugular vein and the carotid artery; crossing the latter obliquely it passes about the muscles attached to the styloid process, and from here lies upon the middle constrictor of the pharynx, just below the lower border of the body of the inferior maxilla.

The hypoglossal nerve leaves the cranium through the anterior condyloid foramen and descends nearly vertically toward the angle of the jaw. It is internal to the carotid artery and internal jugular vein. It passes forward and between these, and finally about the posterior belly of the digastric muscle. It passes around the occipital artery, and over the external carotid and facial arteries. Near the great horn of the hyoid bone, it crosses over the superior laryngeal nerve.

The bone liable to be involved in a necrotic extension from the middle ear is just in front and to outside of the great vessels as they pass through the base of the skull, and just in back of the meningeal artery and inferior maxillary nerve. The distance between these structures is only about half an inch. In exploring this area, the finger is carried through the pharyngeal opening, and then directed outward, pointing toward the external auditory canal. The large vessels can be felt just in back and to inside, and are a good guide to the region we wish to inspect.

When there is a formation of retropharyngeal abscess from a previous suppurative process in the ear, the chances are that we have not only soft necrotic tissue but also diseased and broken-down bone. This necrotic bone demands the attention of the operator, for unless it can be removed the chances are that there will not be satisfactory results following the operation, any more than there are when such conditions are not eliminated during the mastoid or any other operation where bony structures are involved.

We find a diversity of opinion among good operators as to the best methods of reaching and treating retropharyngeal abscess. Burkhardt (17) of Stuttgart in 1888 described a method for external operation, and he strongly advocated his method in a very excellent paper. He advised an incision in front of the sterno-cleido-mastoid muscle, and at level of the larynx. The thyroid vessels are carried backward, and the larynx forward, and the incision carried into the deep retropharyngeal area. In this locality the carotid gives off no branches, and the incision is below the hypoglossal and glossopharyngeal nerves.

Chiene of Edinburgh (18) advocates making an incision from the mastoid proceess downward, just back of the sterno-cleido muscle. Then by direct dissection reach the styloid process, with the muscles and ligament-like fascia; from this the dissection is carried inward and upward into the retropharyngeal space. Those who advocate the external routes are apparently about equally divided as to the choice of these two methods. The advantage claimed for the external operation is that a thoroughly aseptic operation can be performed only in this manner, that diseased tissue can be removed without haste and without danger of materials entering the larynx. This may be true when dealing with broken-down glands (tubercular), but when the infection has come from the ear the chances are that the same pyogenic organisms are present in the abscess which are present in the ear and pharynx. In this case the pharyngeal wound can care for and resist infection as well as if not better than the tissues about the incision in the neck.

Unless there has been extension into the cervical structures, the majority of the operators are inclined to open these abscesses through the pharyngeal wall. Although I made a free opening through pharyngeal wall, and through the ear, and obtained a profuse discharge from both, it was necessary to perform a secondary operation upon one case, and that from the outside, as the pus continued to dissect downward and outward. The diseased bone is at such depth that it is practically possible to explore it only by the sense of touch, and the usual external openings offer no better opportunity than the pharyngeal incision.

This area of disease in the petrous bone is at the level of the condyle of the jaw. The space between the ramus of the jaw and the mastoid process is very narrow at the best. The styloid process with the attached muscle is in this space, and obscures the area of the disease. The only way in which direct inspection of this area can be obtained and still save the articulation of the inferior maxilla is by incising the ramus, and then rotating the upper portion upward, outward and backward. Even by this procedure, we have to sever a portion of the masseter and internal pterygoid muscles. The hemorrhage is hard to control, and the resulting deformity is likely to be marked. The parotid gland would be liable to be injured, and there would be considerable loss of power of mastication.

Were it not for preserving the articulation of the maxilla, the ideal method would be to remove the condyle of the maxilla, and the anterior wall of the external auditory canal. By this procedure the important vessels and nerves could be avoided, and if a given case refused to heal after the other means had been tried and should there be signs of necrotic bone, this operation might become necessary.

There is still another avenue of attack, and that is through the cranial cavity, and of course would only be resorted to in case there were unmistakable signs of cerebral invasion of the suppurative process. A trephine could be made just above and in front of the external auditory canal where by elevating the dura the anterior portion of the petrous portion of the temporal bone could be exposed and explored, and any diseased portion removed.

The first case of retropharyngeal abscess due to extension from the middle ear which came under my care was Mary McD., age 14, who was admitted to the Boston City Hospital, June 21, 1900. She gave a good family history, with the exception of having lost one brother with pulmonary tuberculosis. Her personal history was comparatively free from disease, having had measles at 4 years. The only other trouble was a discharge from left ear. This began when she was a small child. The discharge had varied much in character and amount, but there had been no particular annoyance, except from the disagreeable odor. This had been at various times separated by long intervals of comparative freedom from symptoms. Present history: Four days ago, began with a severe pain in and about left ear, extending into throat and lasting for twenty-four hours. Later, pain was worse in left side of face. Three days ago, throat began to swell, and neck was swollen on outside. For two days has been very hard to swallow, and breathing has been rather difficult. Has been worse to-day, and therefore came to hospital. The patient was a fairly large and well-nourished girl, but presented the appearance of marked sepsis. The temperature was 103°, the pulse 120°. The left side of face was swollen, especially at angle of jaw and below ear. The sterno-cleido muscle was tense. The deep vervical glands on left side were much enlarged. Both pupils were normal. Lungs and heart were normal. Left auditory canal was much swollen, and there was very foul-smelling pus in canal. There was much granulation tissue in the middle ear, and it was impossible to see the general landmarks. A fine aural probe detected areas of bare bone. I tried to direct probe into the Eustachian tube, but was not successful, as the anterior portion of the tympanum seemed filled with soft polypoid tissue.

Examination of throat showed a marked swelling of the posterior pharyngeal wall, mostly on the left side, the lateral wall was pushed forward, carrying the left tonsil with the pillars forward. Had it not been for the pharyngeal swelling, it would have been very easy to mistake the condition for a peritonsillar abscess. The mucous membrane of the right side of pharynx was of a dark red color and swollen, but that covering the pronounced swelling was dark (bluish) red, almost a black, more like that covering the base of tongue when there is a marked varicose condition of the lingual veins. I was much impressed by this dark color, as was Dr. Taylor, the house surgeon. Before I examined the case he told me that the throat was black in color. This dark color was probably due to a venous stasis caused by pressure on the veins relieving this area. There was a wound in the palate which Dr. Taylor had made in the belief that he would reach pus, as he was of the opinion that we had a peritonsillar abscess which had extended backward.

Palpation showed a tense, non-pulsating but fluctuating mass on the left posterior pharyngeal wall, which extended at least as low as the upper rim of the glottis. It took up the whole lateral wall of the pharynx, pushing the left tonsil far forward. The tonsil, however, showed very little if any swelling.

I advised an immediate operation for both opening the pharyngeal abscess and removing the granulation tissue in the middle ear. I did not propose performing a thorough exenteration upon the ear, as I felt the gravest condition was the large collection of pus in the throat, and as the patient's condition was rather poor, the pulse being weak, and the general appearance being that of profound sepsis.

The ear was cleaned with a sterile solution, followed by one of mild corrosive sublimate. Fearing that a tracheotomy might be necessary, the neck was cleansed and a corrosive pad applied. The patient took ether without trouble, and was placed in a semi-Trendlenberg position, with the head held to the left side. The tongue was caught by a tenaculum forceps and carried forward out of the mouth, which was opened as far as possible, and this was sufficient to give fairly good space for operating. To avoid a too sudden escape of pus, I made an incision about 1-3 of an inch in length above and to the left of the median line. Fully three ounces of a rather dark colored, foul smelling pus was immediate evacuated. The odor was similar to that found in a gangrenous appendix. The incision was now enlarged by inserting blunt scissors and then spreading the blades. In this manner an opening sufficient to admit the finger was obtained. I could not reach the bottom of the cavity, but could distinctly feel the great vessels, and while carrying the finger upward and backward it came in contact with rough bare bone. I now passed a probe beside the finger and demonstrated its contact with bone to those assisting in the operation. A very fine probe was used, and while moving it carefully over this area it entered a sinus and through this into the middle ear. I now passed a probe into the external auditory canal, and was able to make contact with the one which was passed from the throat. With a ring curette, as much of the soft granulation tissue was removed from the middle ear as possible, and with the index finger of the left hand in contact with the exposed and necrotic bone in the abscess cavity, I gently removed with the small middle ear curette with a curved shank, a little at a time, the brittle bone, until the curette could be felt with the finger. This was carried as far as I dared, and until the bone was apparently much less brittle. A large abdominal probe was then passed through the throat and out of the ear. It was a question whether to make an external incision so that the deeper portion of the abscess cavity could be inspected and more thoroughly cleansed, or to trust to the drainage already made. The pulse was 130 and not of too good tension, and as much time had already been taken in the operation it seemed best to cleanse the cavity of debris and await developments. The cavity was thoroughly cleansed with sterile water, and a drainage tube passed through auditory canal into the abscess cavity. The pharyngeal opening was packed with iodoform gauze. June 23, the following day, the patient had made a good recovery from ether, the pulse was 96, the temperature fluctuated between 100° and 104°, as shown by accompanying chart. There was profuse discharge through the tube, and also into throat. The packing was removed from the throat, the wound thoroughly cleansed and a fresh iodoform packing inserted. The throat was sprayed every two hours with antipyrin and Dobell's solution.

On June 24, the second day after the operation, the cellulitis of neck had extended over left side of face. The left eye was nearly closed. The lower neck had become swollen, the whole resembling somewhat that of erysipelas. At angle of the jaw and below the ear was a swelling which showed fluctuation. Pressure on this did not force pus through channels already made. It seemed advisable to give vent to this collection of pus, and another operation was advised. The patient was again etherized, and an incision made just in front of the sterno-cleido mastoid. After retracting the skin the fascia was found to be tense, and as soon as this was severed pus of the same character as that found in the other abscess was evacuated. This pus had dissected into the area of. the superior cervical triangle. This cavity was about the size of a dove's egg, and a probe with which I was exploring the walls passed into the abscess cavity above, and was passed into the throat through the pharyngeal opening. The cavity was cleansed with a dull curette and packed with gauze, and a perforated rubber tube inserted. June 25, the day following the conditions were apparently improved, patient felt much more comfortable, had called for food and had swallowed three egg-noggs. The nutrient enemata which she held very poorly were stopped. There was much pus coming from the tube in ear, and also passing through the pharyngeal tube into throat. There was almost none escaping from the cervical wound. Twenty-four hours later, as there was so little discharge from the cervical wound, the gauze was removed. The swelling of face and lower cervical area was very much less, and the general conditions were much improved. The patient was losing the marked septic appearance. By June 28, the cellulitis of the face was nearly gone. There was only slight discharge from the cervical wound, and the discharge from ear, though considerable, was less than at first. The patient was taking considerable liquid, and was gaining much in strength.

There was nothing of importance to note again until July 2, when the tube was removed from the external opening. The pharyngeal opening was becoming small, but considerable pus was removed each day when the cavity was cleansed. There was considerable granulation tissue in middle ear which was removed by curette.

July 9. The pharyngeal wound was entirely closed; the discharge from ear being thick, a solution containing papain and .2 of 1% of HCl was given to use three times a day.

July 21. There has been constant improvement, the discharge has steadily become less and much thinner; at present it is more like serum in appearance. The patient is discharged from the hospital to report at the out patient department for treatment.

She was treated at the O. P. D. for a few days, and then, feeling so well, stopped coming. I saw patient again in January, 1902, when she visited the Boston Dispensary, to learn if anything could be done to improve her hearing. The middle ear was perfectly dry, and had the whitish appearance of epidermis. A probe could not enter the Eustachian tube. The hearing was poor; could hear watch on contact, Politzer's acumeter about three inches. The 5C forks were:

R	*a*	38	43	48	37	7	24'
	b			14			
		C	Ci	Cii	Ciii	Civ	Whisper
L	*a*	0	0	5	8	6	
	b			17			3"

On November 8, 1900, Dr. McDonald of Brookline, who was taking a clinical course with me at the Boston City Hospital when I operated upon the case just reported, brought a patient, Miss Annie W., to the St. Elizabeth's Hospital for examination of her throat. She was 26 years old and had always been well, except for a suppuration in the right ear, which she had been annoyed by, off and on, since a baby. Her father and mother were both alive and in good health. Three brothers and four sisters had always been in good health. She had had attacks of pain in the right side of throat at various times for the past three years. Several physicians, both in and out of hospitals, had examined the throat, and told her there was nothing in the throat to be found, and the pain was probably reflected from the ear, or from some tooth. A spur had been removed from the right side of nose at the Boston Dispensary two years before, in hope that this was the cause of the pain located in the throat. About October 23, she had another attack of the same pain, located in the right side of the throat. There were several attacks of chilliness but no rigor, followed by what she called fever turns. She consulted a physician, who advised her to have a tooth extracted. This was the right inferior twelve-year molar, which had been cariosed for some time. Two days later she had the tooth removed, but was not relieved for four days. Following this there was a cessation of pain for three days, when it began to be more severe than at any other time. There was a distinct chill, and marked weakness. Dr. McDonald was called to see patient and found her with a pulse of 94, and a temperature of 101.8°. This was in the morning of November 2. Examination showed nothing in the throat. The right ear was filled with foul thick pus, and, after syringing, the internal wall was found to be covered with granulation tissue. There was tenderness in front of ear and back of angle of jaw. This he thought due to inflammation in the ear, and ordered hot sterile douches every hour. At 8 o'clock in the evening, the temperature was 103.4° and patient appeared much worse, but Dr. McDonald said he could find no signs of trouble in the throat. He prescribed calomel followed by salts, and applied heat in form of poultices in front of the ear. Following day, the temperature was lower, and the pain and other symptoms seemed relieved. The treatment of ear was continued. There was apparent improvement for two days, when there was another exacerbation. During this attack, no new symptoms or signs presented, and in 48 hours there was considerable improvement. On the morning of November 8, there began to be more pain, and the patient was brought to the hospital, where I saw her at about 11 o'clock in the morning. She had a temperature of 100.8°. There was no external swelling visible, but pressure into space between angle of jaw and the mastoid process caused pain, and there was induration which we could both distinguish. When the mouth was opened there was more pain, yet it was opened without much apparent effort. Both tonsils were rather large and follicular. The whole pharynx was of a darker red color than normal, but I could see no apparent swelling. When the finger was used there was a distinct difference in the two sides, the right was much more tense, but there was nothing to suggest fluctuation, and had I not seen the other case so recently I would not have given much thought to the idea of a retropharyngeal abscess. The right ear showed considerable swelling of external canal, and a firm polypoid mass was in the anterior portion of the tympanum. A probe came in contact with bare bone in the attic, yet I could not carry it anteriorly about the granulation mass. I advised an exenteration under ether, as the ear had been suppurative for years and as the hearing was nil. The patient would not consent to this, but was willing to stand some pain if I could use cocain and curette the soft granulation mass away. Therefore, after cleansing the ear, a cocain and anilin oil solution was dropped in and allowed to remain for ten minutes. I was able to remove quite an amount of this granulation tissue about the opening of the Eustachian tube, but I could not pass probe into tube, yet considerable pus followed its withdrawal. The curette was again brought into use, and more granulations removed. Suddenly there was a flow of about a drachm of pus. As the pain was considerable and the patient somewhat faint, no more was done. The ear was cleansed and a wick inserted. The patient was taken home in a carriage. Following the operation, the patient got marked relief for six days, when in the evening of November 14 there was a distinct rigor, followed by pain in the back and limbs. The throat again began to be very sore. Dr. McDonald cleansed ear and used probe, hoping to give relief, but got no amount of pus. The following morning there was visible swelling of the right side of pharyngeal wall. The patient, fearing that another operation would be advised, and doubtless hoping to save expense, did not wish me to be called to the house. During the next night, however, the swelling advanced very rapidly, there began to be some obstruction to respiration and there was much alarm. I was called on the following morning, November 16, and found that we had a swelling of the pharyngeal wall, much more marked on the right side. The swelling was very marked above, the pharyngeal wall being in contact with the soft palate. The patient was now glad to submit to an anesthetic, but made me promise to make no external incision unless forced to do so. The breathing was much obstructed, and preparations were made to perform a hasty tracheotomy, if necessary. After beginning ether administration I placed a McKenzie forceps back of the epiglottis and then separated blades. This pressed the abscess wall backward sufficiently for a freer respiration. The operating table was a kitchen table, so the patient was placed in a Rose position and the head turned to the right. The tongue was drawn forward by a suture passed through it. I first made a small incision through the pharyngeal wall, a little above the palatal arch, having first lifted the palate with an elevator. A large amount of pus was evacuated, and after having pressed out all possible, the incision was enlarged by scissors. The forefinger, passed through the opening, was carried outward and backward and came in contact with bone. A probe now passed into the ear was easily carried through, and into contact with the exploring finger. As in the first case, I removed considerable bone with the small aural curette, and passed a small perforated tube from the ear into the abscess cavity. As the pharyngeal opening was made high up, I did not pack this with gauze, but left it open. The patient recovered from ether and showed marked improvement immediately. There was a profuse discharge from the ear for the first forty-eight hours. The cavity was cleansed by douching through the ear with a boracic acid solution three times a day, and the solution entered the throat every time.

November 18. Temperature was only one degree high, patient seemed better in every way, and was practically free from pain. The pus began to be less in amount and much thinner.

I did not see the patient again until November 22, for there had been only favorable reports from Dr. McDonald. At this visit, I found the pharyngeal opening closed, and apparently no swelling. There was some soreness upon pressure by the exploring finger. There was only a moderate amount of pus, and we removed the drainage tube from the ear. Orders were given to douche the ear every two hours during the day with warm boracic acid solution. One week later patient came to my office and I was unable to pass a probe anteriorly more than one-fourth of an inch beyond the middle ear. I tried to pass cotton-tipped bougie from pharynx through Eustachian tube, but could carry it only about one-third of an inch into the tube. This led me to believe the tube was occluded. This I found to be the case about a month later. I gave patent a solution of boracic acid and alcohol with calomel to use in ear three times a day. The secretion gradually subsided and was simply of a serous nature at the end of six weeks. I did not see patient again for seven months, when the ear was dry. I could make out none of the ossicles. The hearing was practically nil to air, but patient informed me that she had not heard with that ear for several years. I could not pass bougie nor air through the Eustachian tube.

In the first case, Miss McD. had had a suppurating ear for years before she had the retropharyngeal abscess, and there was a necrotic process extending from the ear to the abscess cavity. Although when I first saw her the abscess was thoroughly developed and I cannot prove that the abscess was not prior to the ear condition, yet with the clear history and the marked necrotic condition of the bone in the anterior portion of the middle ear, together with the advanced condition of the granulation tissues, I am positive that we had an extension from the middle ear.

The second case, developing as it did while under our care, presented no doubt as to the etiology. At the time I met with these cases, I was not aware of the extreme rarity of the condition and was in hopes to meet with more of a like condition. Over five years have elapsed since seeing the last, and I have not seen a retropharyngeal abscess in an adult since. Although, judging by the experience of others, it is doubtful if I see another case in my life, these cases do sometimes occur, and others will see them. For this purpose, I hope this paper may be of value, and also by directing our attention to the possibility of an aural disease extending into and producing a pharyngeal abscess, lead other observers to record the condition of the ears in all these cases. I have been surprised to find that in the reports of so many cases of retropharyngeal abscesses in children, there is so little said in regard to the ears. According to general statistics many of the children reported must have had some co-existing aural disease.

In treating a subject concerning which I have been able to find so little in the literature, and with the personal experience of but two cases, I realize how little I have from which to form conclusions, and such as I present are intended to stimulate discussion, and add new interest to the future study of this subject.

In conclusion, I feel justified in stating, 1st, that retropharngeal abscess in the adult from any cause is a very rare condition; 2nd, that middle ear disease rarely advances forward; 3rd, that when this has occurred, there should be a thorough removal of the granular and necrotic material in the ear, and a free incision through the pharyngeal wall, after which the index finger should be placed in the cavity and act as a guide in using the small aural curette passed through the ear, so as to remove as much of the necrotic bone as possible; 4th, that in the two cases just reported, this proceeding with external opening in the first was followed by permanent relief; 5th, that the external routes of attack are available, and perhaps necessary in some cases; but all of these, with the exception of removing the condyle of the jaw, offer very little if any better opportunity to inspect or attack the bone which is diseased in this particular condition.

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LX.

THE QUALITIES OF THE SENSE OF SMELL.*

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At present, we have three methods of examining the qualities of the sense of smell. The first, which was presented many years ago by Fröhlich,[1] was used successfully by Aronsohn.[2] It consists of causing fatigue of the sense of smell by the use of some odorous substance, and in this condition, it is tested to determine what odors are no longer perceived, what are very faint and what are perceived in the usual degree. Those unperceived are regarded as related to the fatiguing odor. The second method employs mixing conditions and simultaneous compensation.[3] Two odors of weakened intensity are simultaneously used, and it is determined whether they mix or whether they compensate by simultaneous weakening. In the first case, the qualities are regarded as related, in the second as opposed. On this basis, I founded my "Mosaic hypothesis" by joining together in homologous rows the related odor and the peculiarities of clinically demonstrated anosmotics and paranosmotics.[4] The third method is in a way a modification of the second, and will be described in a few words.

From the fact of odor compensation, follows the necessity of representing an odor sensation by means of a vector, i. e., a line in space, whose length and direction is known. The length of the vector corresponds to the intensity; its direction to the quality of the odor. Odors that remain the same in all concentrations (the vast majority) are designated by straight lines; those that change their character with the concentration (antranilic-acid-ethyl-ether, tonor, and many others) by curved lines. Related odors form bundles of vectors; opposing odors, on the contrary, form dispersing vectors, if the vectors are drawn from a common source, a thing which is permissible and even to be recommended.

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*Translated by Clarence Loeb, A. M., M. D.

The mixing of odors it is clear, can be represented by addition of vectors.* If the odors are identical, as e. g., those of camphor and borneol, the vector-sum will possess a direction common to the two original vectors, and a length equal to their combined lengths.

If the odors are related instead of identical, the vector-sum will deviate only slightly in direction and length from that of the above case. Examples of such related but not identical odors are viarvakrol, karvon, safrol and thymol. They mix almost completely, therefore are represented by a bundle of very slightly diverging vectors.

When, however, odors are compensatory, e. g., skatol and kumarin,[5] which, when mixed in certain proportions, almost entirely counteract one another, the vectors either must have an almost completely opposite direction making their sum almost zero, or, better still, in addition to odor vectors, there are assumed to be vectors of loss of odor. In this way, a system of vectors can be drawn giving a graphic representation of qualities of odors. Nevertheless, the hypothesis must still be made that the vectors are active according to the kind of force in the mechanism of resolving them into their component parts. In following out this idea, however, many difficulties are encountered. A prominent one is that one system of vectors will not suffice, and several must be assumed, without their being entirely separated (in which case many modalities could be conceived). Although everything is thus exceedingly complicated, there is yet no reason for refraining from the investigation, which of itself is rational enough. At least, it is partially useful, i. e., for small groups of qualities. A several dimensional complexity, as Wundt calls the system of odorous sensations, never could possibly be simply portrayed, for unfortunately mankind cannot construct solid bodies of more than three dimensions.

I will give examples of the three methods of determining the qualities, and will choose those odors used for measuring precision. As I explained in Fränkel's Archiv., Bd. xv, H. 2, the following are serviceable:

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*To find the sum of two vectors, one is supposed to be moved parallel to itself until its origin coincides with the termination of the other. The line connecting the origin of the first vector with the termination of the second represents the geometric sum. The rationale of the above is easily seen if the vectors are regarded as paths traced by a moving point. It is plain that the point reaches its terminus as well along the vector-sum as along the original vectors.

1. A solution of nitrobenzol in liquid paraffin........1:20
2. A solution of ethylbisulphid in liquid paraffin.....1:10000
3. A solution of skatol in liquid paraffin............1:1000

In the manner explained (l. c.), the olfactory values of these three cylinders were determined to be as follows:

	Threshold.	Odorimeter Coefficient.	Entire Cylinder Length.
Nitrobenzol	0.010 cm.	100	1000 olf.
Ethylbisulphid	0.005 cm.	200	2000 olf.
Skatol	0.003 cm.	333	3333 olf.

For convenience sake, it was found well to provide the air chamber in front of the olfactometer with a cock at its entrance and exit, and with a firm support. The apparatus then has a serviceable form.*

First Method.

The result of the fatiguing method is very simple. It is seen that fatiguing with either of the odors does not cause fatigue for the other two. According to the Fröhlich-Aronsohn's principle, the three odors belong to different specific energies of the sense organ.

Second Method.

According to the method given in the Physiologie des Geruchs, the odor of nitrobenzol belongs to the second class, that of ethylbisulphid to the fifth, and that of skatol to the ninth. The odors therefore are not related to one another, and in agreement therewith are actually found diminished in different degrees in anosmotics, that is in intracranial or essential anosmotics (the diminution is equal in cases of mild, respiratory anosmia). Examples of this kind are found in the Physiologie des Geruchs and in many other works.

Third Method.

For purposes of simplification, let it be assumed that no qualities of odors exist other than the three used in the clinical precision olfactometry. The question then is: in what way are the vectors grouped in space. It is clear that with the as-

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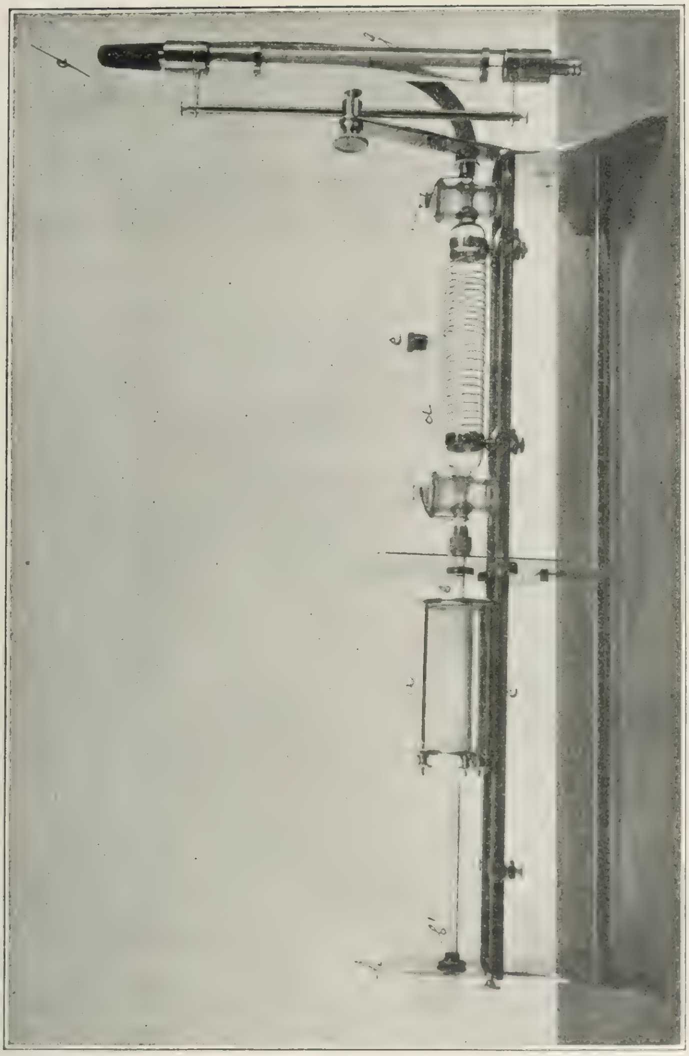
*The double olfactometer for compensation investigations was made by D. B. Viagenaer, Sr., formerly Amanuensis of the Physiol. Instit.; the olfactometer to be described was made by T. Stellema, the present Amanuensis.



The precision-olfactometer consists of: 1. The magazin cylinder, (a) sliding over an inner tube; (b) along a metal plate; (c) subdivided into centimeters. 2. The air chamber, (d) containing 100 cc., with a cock at the entrance and exit and a smelling tube; (e) closed with a metal stopper. 3. The anemodrometer, (f) consisting of a vertical glass tube containing an aluminium plate suspended between two metal threads, which measures the oscillation of the air current by means of its excursions along a millimeter scale (the anemodrometer is gauged by means of a gas meter). The slight width of the path of the current comprises the magazin cylinder, the cocks and the aluminium plate, 8 mm. N. B. 1. The determination of the threshold of the above solutions is made at room temperature and with an air movement of 8 cc. a second. The gear h, with the second inner tube b^1, serves for approximate determinations.

sumed limitations, there can be only three vector directions; it is possible, however, to use as many directions indicating odorlessness as may be desired.

Let the nitrobenzol odor be represented as a vector whose origin is in the middle of space and whose direction for the occasion is vertical. The length depends on the intensity of the stimulus.

The intensity of the sensation bears a certain ratio to the amount of the stimulus which can be expressed by formulas in different ways. According to Fechmer,[6] the formula $e=k.\ log.\ (r\text{-}b)$ almost always applies where e represents the intensity of the sensation, k a constant dependent on the quality of the sensation and the psychic condition, r the amount of stimulus and b the threshold value.

According to Plateau[7] the formula $c=a\ r\ k$ fulfills the conditions better, where c represents the intensity of the sensation, a and k constants, and r the amount of stimulus; the constant k of Plateau's formula is always less than 1.

Of these two formulae, the first is the more probable, since Weber's law, according to Gamble's [8] investigations, has been proven true for odors also, and the fact of the threshold can be doubted here as little as in other realms of sense. But the fact of compensation of odors has caused a remarkable approach to the second formula. If p, representing the olfacton of an odorous substance in the air chamber of a precision measure (which in this case must of course be double), and g, representing the olfacton of another substance, when mixed together give loss of odor, I call this annulling of the two sensations, the compensation of their actions. It may be assumed, then, that their actions reach the consciousness in such a way that their resultant force is zero. Many experiments of older and more recent dates have taught that, in general, where p and g olfactons compensate, the same is true of $2p$ and $2g$, $3p$ and $3g$, etc.

The definition of compensation leaves it undetermined whether the compensation takes place between the two stimuli, their action or the sensations. The former, I excluded years ago; the latter demands the correctness of the psycophysic law, which will now be tested.

These results agree with Fechner's formula only under very special conditions. These latter are either that the percentage with which the stimulis increase causes a distinct increase in the sensation of equal intensity for both odors, so that $p=g$, or that both values lie near Fechner's cardinal value.[9] My method shows compensation of np and ng (when p and g are increased) far beyond the limits just designated and therefore opposes an unsurmountable difficulty to the use of Fechner's formula.

Plateau's formula agrees comparatively well with the method if the constant k is considered nearly equal to 1. But then Weber's law is invalid, which according to Gamble's experiments on the sense of smell cannot be true. Therefore, Plateau's law must be discarded also.

So far as can now be determined, the solution of the contradiction can be made only if it be supposed that, although the judgment of the strength of the sensation takes place in the consciousness according to the Weber-Fechner law, the balancing of the stimulations against one another in compensation is unnoticed and acts apparently according to linear conditions.

Under these conditions, in the spacial representation of odors, the vectors may be measured logometrically only if the sensations alone are considered, and they are to be regarded proportionate to the olfactory values only if the initial effect is considered.

As stated, the latter is our object. The length of the odor vectors are to be the basis of the olfactory values.

To the vertically, upright nitrobenzol vector, a value of 1 has been given in consideration of a certain experiment. After it has been given an arbitrary length and direction in space, this can no longer be done for other odor vectors. It is necessary to calculate the relation of the odor sensations to one another. The second odor precision measure, for example, gives an odor of ethylbisulphid, which has the property of entirely compensating the nitrobenzol odor. The experiment then shows that 190 olfactons of nitrobenzol + 1900 olfactons of ethylbisulphid = 0.

From this, we conclude that we must give to the vector of ethylbisulphid such a direction in space that it can be resolved into two vectors, one of which has an exactly opposite direction and an exactly corresponding length to that of nitrobenzol, and the other of which has a direction which may be regarded as corresponding to one of the many directions of anosmia.

This happens if the ethylbisulphid vector is drawn at an angle of 96° with that of the nitrobenzol. Then, the sum of their actions is zero, and remains zero however it be resolved.

The third clinical odor measure, also, under certain circumstances, compensates the odor of nitrobenzol. The experiment gives:

110 olfactons of nitrobenzol + 3000 olfactons of skatol = 0. According to this, it is necessary to give the skatol vector a direction such that it can be resolved into a vector exactly equal to and opposed to the nitrobenzol and another corresponding to an arbitrary loss of odor. This demands a direction making an angle of 93° with that of the nitrobenzol.

Not only the first and the second and the first and third odor precision measures taken together give loss of odor, but also the second and third. Therefore not only the vectors of ethylbisulphid and skatol have a fixed angle with that of nitrobenzol, but also the angles between themselves is fixed. The experiment shows:

30 olfactons of ethylbisulphid + 3000 olfactons of skatol = 0. From this it follows that the angle between these two is 91°.

The small system* that has been constructed as a result of these experiments evidently consists of 6 vectors, of which 3 represent odors and 3 loss of odor. The 3 odor vectors make fixed angles with one another. Of the 3 vectors of loss of odors, each one is normal to one of the odor vectors and also lies the plane of some other one. No vectors except these 6 exist in space.

Lately, I have used a fourth odor measure for clinical precision olfactometry, whereby a new principle is used. If equal molecular percentages of naphtholin and brom-camphor are mixed at 40° C^{10}, a substance is obtained which is suited to the formation of olfactometric cylinders. The mass can be at once moulded into the form of a cylinder with a diameter of 8 mm. which can take the place of a magazine in the olfactometer. Only, such a solid, odorous cylinder should be enclosed in glass and covered in front with metal so that the odor of naphthalin may be confined. The brom-camphor-naphthalin cylinder smells of naphthalin, an odorous substance which belongs to the 6th class of odors. Its threshold is 0.0005 cm. Its odorimetric coefficient is therefore 2000. In this unusual intensity of the substance rests a great advantage, because as a result thereof the cylinder may be used in high degrees of anosmia. Consequently, since the eutecticum of a mixture is a very important point from a physical point of view, this solid mixture has lately been used for olfactometry.

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*It is usual to consider positive the angulation opposed to the movement of the hands of the clock.

Let us try to arrange a place in our vector system for the new cylinder. It can be brought into compensation with the three other precision measures, causing the following equations:

600 olfactons of nitrobenzol +
1200 olfactions of naphthalin = 0
200 olfactons of ethylbisulphid +
8000 olfactons of naphthalin = 0
3000 olfactons of skatol +
300 olfactons of naphthalin = 0

From these equations it follows, first, that the naphthalin vector makes an angle of 94° with that of nitrobenzol; furthermore, that the vectors of naphthalin and ethylbisulphid have an angle of 92°; finally, that the angle between the vectors of skatol and naphthalin is 96°. From an earlier compensation, that between ethylbisulphid and skatol, there resulted another skatol vector which is not identical with the one just described. This cannot be caused by mistakes in the equations, since the variations of the figures cannot be so great that both skatol vectors fall together. With the assumption of 2 vectors for one and the same quality of odor, the rationale of the system becomes destroyed. The delineation of vectors is prevented as soon as it is used for more than three compensating qualities, a fact which is self-apparent, since a many dimensional complexity is then demanded.

We unfortunately have to omit graphic representation when we desire to delineate the relations of qualities of odors to each other if the numbers have to be given and to be arranged under control. Here we will refer to the fraction *p*-*g* where *p* and *g* represent olfactons which compensate in their simplest condition. The fraction states not only that *p* olfactons of one and *g* olfactons of the other substances when taken to gether give loss of odor, but also that this is the case with

$2p$, $2g$, $3p$ and $3g$, $4p$ and $4g$, etc. It, therefore, includes all reciprocal relations that can exist between the two odors.

The following odorimetric coefficients belong to the four cylinders which we have dealt with:

Nitrobenzol	100
Ethylbisulphid	200
Brom-camphor-naphthalin	2000
Skatol	333

Each two combined in the ratio p-g gives the following:

$$\frac{\text{Nitrobenzol}}{\text{Ethylbisulphid}} = \frac{1}{10} \qquad \frac{\text{Ethylbisulphid}}{\text{Naphthalin}} = \frac{1}{40}$$

$$\frac{\text{Nitrobenzol}}{\text{Naphthalin}} = \frac{1}{20} \qquad \frac{\text{Ethylbisulphid}}{\text{Skatol}} = \frac{1}{100}$$

$$\frac{\text{Nitrobenzol}}{\text{Skatol}} = \frac{1}{27} \qquad \frac{\text{Naphthalin}}{\text{Skatol}} = \frac{1}{10}$$

The above schema shows schematically very clearly the relations between the qualities of odors studied by us. From this it is clear that spacial representation is impossible. *A fortiori* a plane representation is insufficient. Now the elements corresponding to the specific sensations, the olfactory cells, are found distributed in a plane surface, the mucosa of the regio olfactoria. There must, therefore, be a spacial representation, but it is not actually necessary to represent the abstract relation which we conceive exists between the odors. They find their anatomic substratum only in the very complicated tracts of the central nervous system. Whether, as the "Mosaic theory" assumes, the specific elements of related qualities lie topographically nearer or further from one another, can not be determined *a priori.* Clinical investigations will gradually have to teach us more about that.

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LXI.

THE EARLY HISTORY OF LARYNGOLOGY IN AMERICA.

By Thomas J. Harris, M. D.,

NEW YORK.

The sun shines both upon the just and the unjust; no single territory or country can claim a monopoly of its rays. History has repeatedly shown that no great movement or discovery is the product of any one man's brain. The hero of the moment is but the mouthpiece of numberless generations of searchers and thinkers. Martin Luther did not make the reformation of the 16th century. The times were ripe and he with Calvin and Melanchthon and many an other only gave it expression. Columbus as the discoverer of a new continent was but the victor where many ran. The discovery of galvanism and faradism belongs to no single mind. To this rule the great advances in medicine are no exception.

The celebration in honor of the seventieth birthday anniversary of Professor Bernhard Fraenkel of Berlin, marking as it does the rounding out of a career which is coincident with the history of modern laryngology, is a fitting time to recall what share, if any, America had in the beginnings of that science. The gathering held recently in London, in honor of Senor Garcia, served to impress on us how young this specialty is. To Garcia, a Spaniard, living in England, is accorded the proud honor of being the discoverer of the laryngoscope. Türck and Czermak, of different nationalities, but both living in Vienna at the time, contested the title of first employing it in medicine.

What share was our own country taking in these strivings and seekings while still "rosy fingered Dawn" filled the laryngological sky! To the older members of our cult there is no need of rehearsing this tale. The graphic account of Elsberg is still fresh in their minds. But, alas, the ranks of those who heard Elsberg is ever growing thinner. Since that day a new generation of laryngologists, mighty in number and boasting in the strength of their youth, has arisen, to whom this story is a dim tradition or an unread tale.

Let it be said, then, that America's share in this development is one which can be pointed to with just pride. Keen minds on this side the water were pondering over the same problems which confronted Türck and Czermak.

Living in Woburn, Mass., at this time was a young physician, a graduate of Harvard, who had busied hmself with a solution of the problem how to see the larynx by means of prisms. After much study he submitted his ideas to G. B. Clark of the firm of Alvah Clark & Sons, the celebrated lens makers of Cambridge, Mass., with the request that he construct an instrument according to the drawing. This with certain necessary modifications, Clark did in the year 1857, as is shown by the correspondence which passed between them and which was later published by Elsberg. Cutting afterward moved to New York City, where he is still living. While this arrangement of mirrors was, as far as we can learn, never actually used, it is of no little interest to know that such work had been done by an independent American mind.

Cutting's work was theoretic. For many years antedating him, the true pioneer in laryngology in this country had been daily treating diseases of the larynx by the same measures we employ today. The name of Horace Green will ever stand as the father of American laryngology. Few men in the medical profession have been more bitterly assailed. He, like many another pioneer in the fields of truth, was in advance of his generation, and ridicule and calumny were his lot. More fortunate than the majority of that class, it was his happy fate to live to see his claims vindicated.

Green was born on Dec. 24, 1802, and died Nov. 29, 1866. After graduating in medicine, he settled in Rutland, Vt. In 1835 he moved to the City of New York. He was one of the founders of the New York Medical college, of which he was president, and where for a long time he occupied the chair of medicine.

He received many honorary degrees, including that of LL. D. from the University of Vermont. He continued to practice his specialty till shortly before his death. His biography speaks of his being endowed with a strong religious sentiment.

Throughout the long years of controversy in which he was engaged, he succeeded in retaining the confidence and friendship of the leaders of the profession in New York.

Green in 1846 brought out his Treatise on Disease of the Air Passages. In this he claimed to cure diseases of the larynx by direct applications of varying solutions of nitrate of silver, introduced upon a sponge with a curved handle. He states that he first did this in 1838, shortly after his return from a year's visit to Europe. The idea of employing direct medication, he ascribes to a conversation with an English physician whom he met while abroad, and disclaims adopting it from Trousseau and Belloc. His was the first treatise on laryngology published in America.

The publication of Green's book provoked intense opposition. As he says, for many years he refrained on this account from again asserting his views. In 1857, however, he once more set them forth in a paper read before the New York Academy of Medicine. In this paper he claimed to be able not only to introduce instruments into the larynx, but also into the bronchi, and asked for a committee from the Academy to be appointed to investigate his claims. This was done and under the chairmanship of the celebrated Valentine Mott it reported that while the latter part of his contention lacked sufficient proof, in the main his claims were just.

While Green stands forth as the one conspicuous laryngologist of the first half of the last century, others of his countrymen had shown their interest in this special field of science. Cheesman, in 1817, described in detail a laryngeal growth. In 1828 Physick, of Philadelphia, published a description of the tonsillotome which bears his name. Before that time it was customary to put a ligature upon the tonsil and allow it to remain for several days. In 1828 Matthews devised another tonsillotome, and in 1832 Fahnestock, of Lancaster, Pa., described one which closely resembles the present Matthieu's.

Acute and chronic laryngitis, which are wont to present to us no symptoms of gravity, were to the men of that day among the most deadly of diseases. The literature of those years is full of reports of a suffocative form of laryngitis usually fatal which is rarely met today. It was in its chronic form, held to be almost invariably tubercular in origin. Green published in 1858 the fourth edition of his work, as well as in 1852 one on the Treatment of Polyps in the Larynx. Here he shows a number of instruments and reports several cures by intralaryngeal removal.

In 1858 Czermak published his first paper on the laryngoscope. Two years later Dr. Hugh Strangenwald read a paper before the New York Medico-chirurgical Society describing it. March 6, 1861. Dr. Wm. H. Church presented the subject at an interesting meeting of the New York Academy of Medicine. On that occasion Dr. Ernest Krackswizer asserted that in all probability he was the first person to use the laryngoscope in America. He used a reflector devised by Semeleder, an assistant of Czermak. Among others, Horace Green was present and reported his experiences, with the new instrument. What a memorable evening for that battle-scarred old warrior! How proud he must have felt to hear his contentions of a lifetime, after meeting allegations of the gravest character, fully justified!

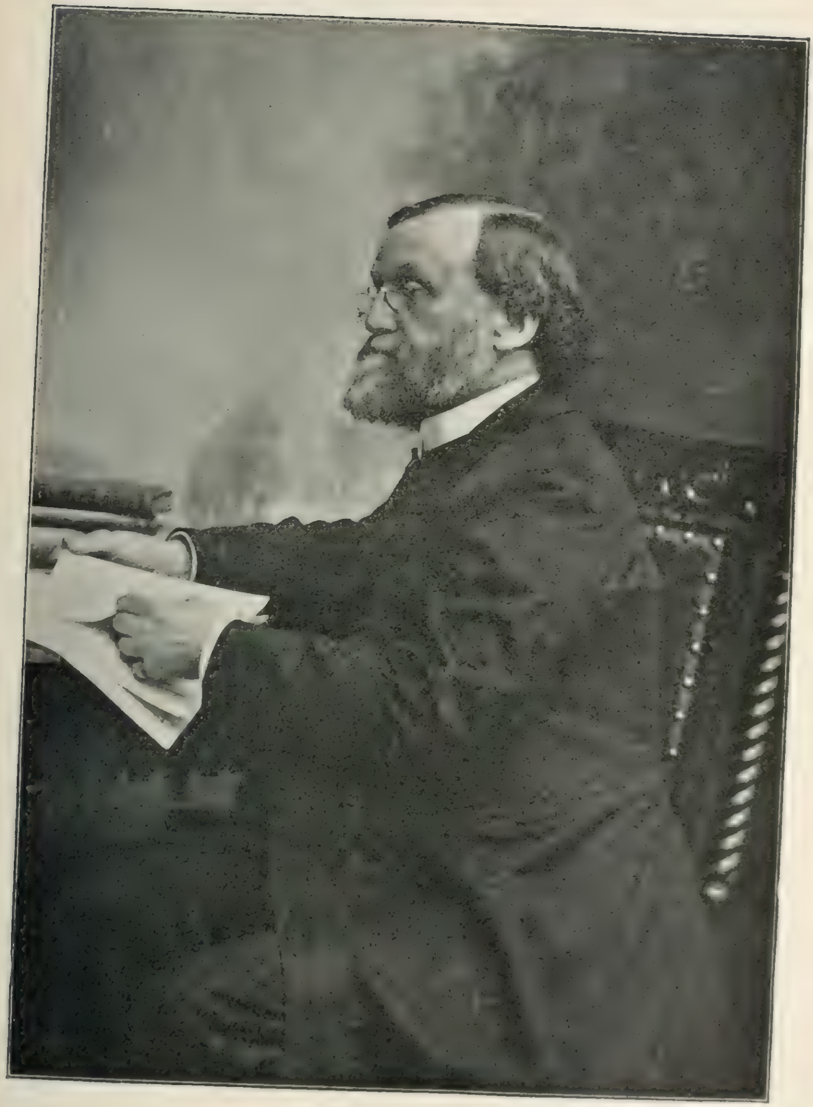
If Green was the prophet proclaiming out of the darkness, the coming of good things laryngologically, the apostle who announced the actual dawn of it was the lamented Louis Elsberg. By common consent Elsberg more than any one else was the leading figure in making laryngoscopy and all represented by it, popular with the profession in this country.

Elsberg was born in Westphalia in 1837. He came at an early age to this country and graduated in 1857 from the Jefferson Medical College in Philadelphia. About 1861 he returned from Europe, where he had seen Czermak's work, and settled in New York City, where he at once began to preach the new doctrine of laryngology. During the years 1861-4 he published several papers on this subject as well as addressing the New York Academy of Medicine. To him belongs the honor of giving the first instruction in laryngology in America, which was in 1861 at the Medical Department of New York University. Two years later he established the first laryngologic clinic in this country in connection with the same institution. Others followed in Elsberg's footsteps soon, among whom was the distinguished J. Solis-Cohen of Philadelphia, who still survives. The speciality grew with such strides that in 1873 the New York Laryngologieal Society was founded, the first of its kind here and possibly in the world, and in 1878 a number of those interested in the subject met in Buffalo upon the invitation of Dr. Frank H. Davis, of Chicago, and organized the American Laryngological Association. The first meeting of this society was held in New York City under the presidency of Elsberg in 1879. At that meeting, he delivered the address from which much of the material of this paper is obtained. Joined to the paper was a complete laryngological bibliography from early in the century to the year 1879.

In the less than twenty years which followed Elsberg's first lecture and clinic, the specialty spread so that at the time of his inaugural there were 25 universities and colleges where special instruction was given in laryngology in 1879.

Elsgerg died from pneumonia in 1885 at the age of 48. In a biographical sketch written shortly after his death, Delavan speaks not only of his high scientific attainments but of his strong social nature and charming personality. John H. Douglas, Lincoln, Seiler, Allen, Jarvis, Daly, Asch and Davis followed Elsberg one by one. The majority of those, however, who stood shoulder to with him, are still alive, and actively engaged in professional work. The amount of valuable scientific work they have done in these last twenty years is known abroad as well as here, and the names of Cohen, Bosworth, Shurly, Ingals, Roe and Lefferts among others will long be remembered as among those who did most to put laryngology upon the high plane which it at present occupies.

LOUIS ELSBERG, M. D.



EPHRAIM CUTTER

M. D., Harvard, 1856 and U. Penna 1857.

M. A., Yale, 1855; LL. D., Iowa College 1887.

LXII.

REMINISCENCES.

By Ephraim Cutter, M. D., LL. D.,

WEST FALMOUTH, MASS.

I remember calling on Horace Green at his office. He was a very pleasant man. With reference to the patient about whom I consulted him, he said that I had passed a sponge probang with nitrate of silver into his trachea. As I could not see, I could not determine the matter for myself. It was probably as he said, but my experience at that time made me think that it might have been the esophagus.

Later, in Vienna, Semeleder showed me the three valves of the larynx in action on himself.

In 1865 I became acquainted with Louis Elsberg, the father of American laryngology. The Massachusetts General Hospital at Boston had sent a Mr. Capen to me at Woburn, Mass., for diagnosis. I wrote simply what I saw. They sent him to Elsberg, who had written a prize essay on Throat Diseases and Laryngeal Growths. Elsberg was delighted with my report because I did not state that it was cancer but gave the characteristics as I found them. He said this was the best way to do.

Elsberg was of great inventive genius—an honor to his profession. He was one of the best electricians that I have ever met.

We studied up together things connected with laryngology and it was delightful to us both to see each other's inventions. It was a sad day for the profession when his sun set in medical glory; a great gap was made in my medical life when he was removed. His technic and tactile gifts made patients like to be treated.

Dr. J. Solis-Cohen, though still living to bless the world, should be mentioned. He and Elsberg were like Damon and Pythias, one in New York, the other in Philadelphia. It was a delightful time for me when they came to Woburn to assist in my operation for removal of growth by thyrotomy without the tracheotomy tube. Some of these cases were very interesting. The first, operated upon in 1866, was without recurrence for 20 years. Another patient in whom new vocal bands were made by scissors, recovered phonation.

In the course of my long experience with laryngology, I have made the following observations:

1. Enlarged fibroid arytenoid cartilage, cured by scarifications with a knife made for it.
2. Ulceration in the pyriform fossa often causes cough.
3. Pharyngitis sicca easily cured by drinking, 4 pints of hot water one hour before each meal and before going to bed.
4. Adenoids just behind the middle of the lateral pillars of the soft palate are often the cause of throat trouble.
5. Breath bands are to be preferred to false vocal bands because they control expiratory breath.
6. A young lady studying for the opera in London could not reach high C. Treatment of the vocal bands was without avail. An adenoid was treated with liquor ferrous sulphate, U. S. P., and she recovered this note.
7. Uterine disease will cause throat troubles.
8. A right and left Eustachian catheter, shown at the International Congress at Moscow, conforms to the natural angles.
9. Speech and song differ entirely in the length of the basic vowel sounds.
10. Thus phonation is subject to musical laws.
11. Hence phonation should be in the chord of the key-note of audition.
12. Music and speech belong to the spiritual kingdom of food.
13. Tremolo singing of sacred music is unlaryngologic and indicates partial paralysis of the vocal cords.
14. Laryngologists would do well to lay down laws of speech and song, because speech and song are functions of the larynx belonging to its physiology.
15. Speech and song are most wonderful things laryngology has explained better than anything else. They are treasures of the air, all but priceless. They are precious gifts of God worth more than gems and gold. Languages and tongues in Holy Writ are seen to come directly from the Creator.
16. I can only add that in 1850, I had a most earnest desire to see my own larynx, *in situ naturali*. I had heard of Garcia's

invention; I sought for it in the armamentarium of medicine, but could not find it. I had to invent for myself. I took a microscope as a pattern, made drawings and explanations to Alvah Clarke and Sons, the makers of the largest telescope, and they constructed a laryngoscope for me in 1859. I did but little with it.

I saw Czermak at Paris in 1862 demonstrate his own larynx. I also viewed the photographs of his larynx. He said that he could not get the thyroid insertion. After this I had my tinsmith construct my laryngoscopes out of tin and mirrors. They were successful.

In 1866, I photographed my own larynx and was fortunate enough to finish Czermak's work as to the anterior insertion. Copies are in the U. S. Army Museum, Washington, D. C.

17. The general condition of the system should not be forgotten. The Almighty within us is trying to cure us of our physiologic virus. So it is of importance to see that the system is well fed and cared for as to the mineral, animal, vegetable and spiritual kingdoms.

LXIII.

CONTRIBUTION TO THE ETIOLOGY OF ATROPHIC RHINITIS.

(RHINITIS ATROPHICANS SIMPLEX ET FOETIDUS SEU OZENA.)*

By Dr. John Sendziak,

WARSAW.

Atrophic rhinitis is among the more common forms of chronic rhinitis, as I have found the disease 1142 times in about 20,000 private and dispensary patients (642 dispensary and 500 private), more than 5½ per cent. Of these cases, 782 were of the simple variety and 360 of the fetid or ozena, making the proportion 2 to 1.

Krieg of Stuttgart states that the fetid form is much more frequently found, which we must assume to be due to the local conditions in Germany, as Jurasz of Heidelberg also found ozena more common than the fetid form (170 to 45).

In Jurasz's clinic the cases of atrophic rhinitis numbered 215 out of 4000, or about 5 per cent.

My figures show that the disease is more prevalent in the poorer classes, viz., dispensary patients; the relation being 642 to 500, or 6.5 per cent to 5 per cent—there being about 10,000 patients in each service.

Out of 1616 cases of chronic rhinitis, 1142 showed evidence of the atrophic form (782 simple and 360 fetid) and 1048 of the hypertrophic variety.

The statistics of Jurasz differ somewhat from these. He found atrophic rhinitis in 215 cases (45 simple and 170 fetid) and hypertrophic 400, almost twice as many. It is striking that Jurasz found the hypertrophic form the most commonly while I found it least frequent. All this is probably dependent on the local conditions of the countries in which the observations were made.

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*Portion of a large monograph to be published later.

All writers agree that the disease is found more frequently in females than in males (Hamilton, Bresgen, Grosskopf); according to Schaefer one and a half times more; Gerber in 71 per cent of the cases; Michel twice as often and Jurasz almost twice as often (140 to 75). Krieg reports a still larger percentage, 94 to 44, and Höffler and Wyss still larger, 4 to 1. Voltolini holds that the disease is pathognomonic for women.

My own cases differ fundamentally from those just given, although I have also found the disease more common in the female than in the male, especially the fetid form. My figures were 574 females and 568 males. Only one observer, Schmiegelow, of Copenhagen, gives a similar finding, i. e., about equal for the two sexes. Again we must ascribe to the different local conditions this large difference in the sex of patients suffering from the disease. Of the 574 women, 330 were married, 204 not married and 40 widows, which would indicate that married women are particularly predisposed to atrophic rhinitis, especially of the fetid form. This fact probably finds an explanation in the presence of diseases of the genital organs.

A striking fact in my observations is the exceedingly frequent occurrence in the fetid form of the disease in Jews (232 out of 1142 cases, about one-fifth), proving that this race is specially predisposed to this disease, possibly due to the unhygienic conditions under which the people of this race live. I have not found that other writers on the subject have noticed this fact.

The following shows the ages of patients affected:

Between	5	and 10	58
	10	20	272
	20	30	314
	30	40	230
	40	50	134
	50	60	78
	60	70	38
	70	80	12
Total			1142

It thus appears that the disease occurs mainly during the period of sex maturity (from 10 to 20) and still more frequently between 20 and 30 years. This is also shown by Jurasz, who however found that the disease was most frequent between 10 and 20 and slightly less between 20 and 30 years of age. He very properly considers that it depends upon the various disturbances which usually occur at this period of life, especially chlorosis in girls.

The youngest of my patients was 9 months of age, which would tend to show that the disease may be hereditary. Valentin and Kayser accept this as the only explanation of the origin of the disease; Schmiegelow does not agree with this view, having found two cases which began at the 34th and 28th year. Roe found the disease always in children and Riviere in 10 per cent of the cases. At any rate my statistics show that no age is exempt from the disease, even the most advanced (12 cases between 70 and 80 years).

Krieg and Grosskopf very properly state that the disease may occur in the rich as in the poor, in the latter more commonly. Voltolini opposes this view.

The disease was found in girl pupils 52 times, maid-servants 32, governesses 16, and seamstresses 12.

Krieg found ozena mainly in girls in orphan asylums, maid-servants, girl pupils and seamstresses and more rarely in press women, ballet dancers, telephone operators, etc.

In males the following are the occupations:

Merchants	70
Pupils	68
Land owners	66
Civil officers	56
Priests	34
Boys, school	28
Military officers	24
Physicians	22
Teachers	20
Bookkeepers	12
Clerks	12
Administrators	10
Apothecaries	10
Locksmiths	10
Boarding house keepers	8
Confectioners	6
Engineers	6
Manufacturers	6
Attorneys	6
Boatmakers	6
Tanners	6
Coal men	4
Hatmakers	4
Notaries	4
Mechanics	4
Technologists	4
Booksellers	4
Directors	4
Carpenters	4
Butchers	2
Literary men	4
Masons	4
Brewers	2
Watchmen	2
Cashiers	2
Musicians	2
Gardeners	2
Draftsmen	2
Telegraph operators	2
Bakers	2

Coachmen	2	Tailors	2
Foresters	2	Geometricians	2
Machinists	2	Judges	2
Soldiers	2	Painters	2
Laborers	2	Policemen	2
Restaurant keepers	2		
Wards	2	Total	568

The above figures agree with those of Krieg, which show that atrophic rhinitis, especially ozena, is more common in merchants and male pupils and then in land owners, civil officers, physicians and teachers.

The striking frequency of simple and fetid atrophic rhinitis in school children is explained on the basis of the disturbance of the general condition (anemia, chlorosis and scrofulosis), and upon the intellectual work done and other causes, especially of a sexual nature. The frequent occurrence in merchants and civil officers is probably due to the continual respiration in shops and in places where they devote themselves to their profession. It is striking, however, that the disease is met so uncommonly in apothecaries. It is also very difficult to explain why the disease occurs so frequently in land owners who live under favorable conditions.

The etiology of simple as well as fetid rhinitis has not been absolutely solved. We know only that the following are the important predisposing causes:

1. Trauma which was observed 8 times by me (twice in 215 cases by Jurasz). It generally occurs in childhood when the child first begins to walk, or later following a blow on the nose. As indirect trauma, there was first deviation of the septum and then chronic atrophic rhinitis or ozena.

The disease may occur after operations on the nose, especially resection of the turbinates. Such a case was observed by Stewart. Palse observed a case of typical ozena in an anemic woman following galvano-cautery operation on the inferior turbinate.

In the main I consider that illadvised local treatment of nasal stenosis, which has been so prevalent of late, may act in a negative sense upon chronic rhinitis, resulting in the simple or fetid form of the atrophic variety. John Mackenzie calls attention to this.

2. Acute infectious diseases play a very important role as a

predisposing cause. The most important are influenza (16 times in my cases), diphtheritic croup (4), typhoid (4) and smallpox (2). Thomson also observed one case following typhoid, and Jurasz mentioned scarlatina (2 cases), measles (1), and erysipelas (1).

3. General pathologic processes such as chlorosis and anemia (36 cases), scrofulosis (112), and tuberculosis (84 cases, in 24 of which the larynx was involved). Jurasz noted the occurrence of anemia and scrofulosis very often.

The mutual relation between tuberculosis and atrophic rhinitis is very important. Brindel, for instance, believes that ozena unquestionably predisposes to tuberculosis. Pluder, Swain, Grünwald, Theisen, Freudenthal, Siebenmann and Wyss agree in this opinion. Our figures show that this is true by the coexistence of these two diseases in many cases. Hamilton observed 6 cases of tuberculosis in 170 of ozena, Harris in 50 per cent of the cases, and Wyss in more than half. Clark maintained that ozena occurred in more than half of the cases of tuberculosis of the larynx; with this view Hubbard and Newcomb did not agree (the latter author did not find ozena present in 70 cases of tuberculosis). In the 1142 cases of atrophic rhinitis which I have observed, tuberculosis was present 84 times or in 7.4 per cent of the cases. In my opinion there is no doubt that there exists between tuberculosis and ozena a causal relation which is also found in relation with anemia and chlorosis, besides the ozena may cause the development of a tuberculous process, which Krieg regards as more frequent.

Siebenmann's case proves this: A man 21 years old was affected with ozena for 15 years and with tuberculosis for two years. I also observed a similar case: A girl, 17 years old with a typical recent ozena, accompanied with frequent expistaxis, developed an acute attack of pulmonary tuberculosis (phthisis florida) with fatal issue, while under my care.

Some authors (Leiss, Watson) identify ozena with lupus (erythematodes). Syphilis is undoubtedly to be numbered among the predisposing causes of atrophic rhinitis; it was found 114 times in my cases, about 10 per cent.

Jurasz also found this disease commonly among his cases (13 times in 170). The following writers ascribe to this disease an etiologic significance: Stoerk, Hoeffler (hereditary lues), John Mackenzie, Gerber and Thost. Rundström on the contrary denies it.

Among the other pathologic processes which have a predisposing influence in the causation of atrophic rhinitis, I must mention obesity (24 cases), uric acid diathesis (30), neurasthenia and hysteria (48 and 36 respectively). The latter may be the result rather than the cause of the condition.

4. Tobacco is also an etiologic factor. I found it 120 times, about 10.5 per cent. Very little attention has been paid to this. Overuse of alcoholics was also found relatively often (40).

5. Pathologic conditions of the genito-urinary apparatus are important predisposing causes. Most important are the changes in menstruation (amenorrhea, dysmenorrhea and menorrhagia) of which I noticed 8 cases, climacterium 8, pregnancy 16, nursing 12, and metritis 4. A common proof of the causal relation existing between these two is the well-known lessening of the disease during menstruation. Masturbation was quite commonly (8) found in both sexes; I ascribe to it a predisposing role in the development of the disease.

6. General pathologic processes. Bright's disease was observed 8 times in my cases. It is well known that pharyngitis sicca which is an almost constant accompaniment of atrophic rhinitis is to a certain degree pathognomonic of the disease. Heart disease was noted 4 times, angina pectoris 4, paralysis agitans 2, pleuritis 2, cystitis 2 and actinomycosis 1. Two cases were idiots.

The questions of diathesis and contagiousness are important. Diathesis is undoubtedly influential in causing the disease; its simultaneous appearance in parents, children, brothers and sisters is evidence of this. In my cases, the disease occurred simultaneously in mother and daughter 5 times, both parents and children 4 times and in brothers and sisters 10 times. Such cases are well known in literature (Rosenfeld, Loewenberg, Paulsen, Strübing, Stoerk and Krieg).

My statistics are specially important as to the diathetic relation of mother to daughter.

At the beginning of the seventeenth century Crat was of the opinion that it was contagious. In more modern times, the opinion is held by some, especially Capart, while Brügelmann and Hamilton deny it.

Up to the present time, we have no positive proof of the contagiousness of the disease, yet autoinfection is indicative (involvement of the larynx and trachea without the pharynx being affected).

Strübing inoculated the discharge from ozena on the mucosa of a healthy nose in a tubercular patient. Death followed in four weeks. Macroscopically crusts were found, microscopically special bacilli.

Lately Perez from minute bacteriologic investigation comes to the conclusion that infection is possible from dogs as well as men.

There are various theories of the cause of atrophic rhinitis which have their adherents and opponents. The more important are:

1. Hereditary, constitutional, and Bosworth's theory.
2. Mechanical (turbinated bodies, etc.).
3. Focal (lateral sinus theory).
4. Chemical.
5. Trophoneurosis.
6. Parasitic—the most important and best.

1. Zaufal first drew attention, in 1874, to the wide nasal cavities as a congenital cause of ozena, while the hereditary influence was maintained by Hopmann (shortness of the nasal septum), Rosenfeld; congenital atrophy of the turbinate, Kayser, Valentin, Hill, Somers and Shrimunsky.

Trousseau's constitutional theory is one of the oldest, and was supported by Capart. It is based on the fact that atrophic rhinitis is the result of constitutional diseases (scrophulosis, tuberculosis and syphilis) hereditary and acquired. Above all, syphilis seems to play the most important role, an opinion supported by Fabricius Ab Acquapendente, in the middle ages, and in more modern times by Stoerk, Gerber, Schaeffer, who found 20 syphilitics (2 hereditary) among 119 cases; Schroetter, who found 34 out of 77 cases; Mackenzie 3 of hereditary and 3 congenital and Jurasz 13 out of 170.

In addition, John Mackenzie and Thost even now ascribe to this disease an important influence, while Rundström and Gottstein are of the opposite opinion. The latter found no cases in his practice.

I found syphilis in 114 out of my 1142 cases (10 per cent), so I consider that syphilis is of importance in the etiology.

Scrofula is also an important predisposing cause of atrophic rhinitis. Schaeffer observed the disease 99 times in 119 cases, Schroetter 10 in 77, Gottstein 2 in 12, Jurasz 7 in 170, and it was found 112 times in my 1142 cases (about 10 per cent).

I have already mentioned the relation of tuberculosis to atrophic rhinitis. As to the simultaneous ocurrence of the two diseases, I noted it 84 times in my cases, 7.4 per cent, so the relation between the two cannot be denied. Brindel, Plunder and others are of this opinion. Stoerk, Schmidt, Krause, Bresgen and Watson ascribe to gonorrhea some significance in the etiology of the disease.

2. Most authors, such as John Mackenzie, Gottstein, Schaeffer, Moure, Flesh, Williams, Hajek, Compaired, Clure, Schech, M. Schmidt, Watson and Waterman believe that atrophic rhinitis always results from hypertrophic. My experience confirms this, for I found it present 60 times.

Others oppose this view, particularly Mulhall, B. Fraenkel, Wyss, Hopmann and Roth. Walb claims that the atrophy is due to the presence of the crusts.

Zaufal, regarding the affection as congenital in character, maintains that on account of its capaciousness, the nasal cavity, loses its property of removing the nasal secretion in proper suitable quantities, wherefrom the nasal mucus becomes thick and on account of the bacteria acquires a bad odor (fetor). Saenger, Barth, Brügelmann, Aysagner, Catmatter, Campes, Salles, Todenat and Rouge support this view and likewise Demme, who draws attention to the perpendicular position of the nose in patients suffering from ozena.

Heymann explains this condition somewhat differently: the inspired air passing through preternaturally wide nostrils is not sufficiently warmed or moistened, and on account of this the dryness and interference with secretion cause the bad odor.

On the other hand, Sauvage and Fillet hold that the narrowness of the cavity is responsible. Hopmann, concludes that the nasal septum is much shorter anteroposteriorly in cases of genuine ozena, based on numerous measurements of the length of the septum and width of the epipharynx. He agrees with Zaufal, of course, that the affection is of congenital origin; in this Grünwald does not agree.

Recently Berliner maintained that the principal cause is the adhesion of the anterior part of the middle turbinate to the septum in cases of abnormally narrow nasal cavities. This causes a stoppage of the secretion in the superior part of the nose with all its consequences (fetor, etc.). This theory, however, found no supporters. On the contrary, it is denied by Kayser and Demme.

In some of my cases, where this condition existed (septum always deflected), the symptoms of the atrophic rhinitis were more expressed on the opposite side, which naturally is in opposition to Berliner's theory.

To this category, at least in some degree, belongs the theory of Bosworth (1900), according to which the disease is a result of purulent rhinitis of childhood. "Children are very predisposed to the inflammatory catarrhs; the first result is increased secretion. The process spreads slowly into the glandular tissue, the secretion becomes thicker and dries in the form of crusts which by pressure repress the blood flow to the mucous membrane. The dry secretions are not expelled, decompose themselves and cause the characteristic smell (fetor)." The opinion is shared by American and English writers such as Richmond MacKinney, L. Lack, Spencer and Brenner.

3. As I have stated in the introduction, the opinion was still held at the end of the seventeenth century by Vieussens, Reininger and Güns, that ozena was not a separate disease but a symptom in suppurative disease of the lateral sinuses of the nose. In more recent times, this opinion is gaining ground. Michel and Schaeffer noted that ozena disappeared after cure of sphenoid sinus suppuration.

The principal exponent of this, the so-called focal theory, is Grünwald of Monaco, who maintains that ozena is always caused by suppurations of the lateral sinuses of the nose, especially the ethmoid and sphenoid. The following favor this view: Bresgen, Nöbel and Löhnberg, Hajek, Wertheim (autopsies), Moll, George, Ryerson, Porcher, North, Winslow, Jacques, Theisen, Mayer, Logan, Farlow, Langmaid, Chatellier, Grant, Berthold, Cobb, Ricord, Brieger, Cassel, Robertson, Flatau, Spicer, Tissier and Harris.

Most of these authors regard ethmoid and sphenoid disease as the cause of ozena. Langmaid and Flatau observed recovery follow operation for empyema and caries of the sphenoid and ethmoid sinuses. Others hold that it is diseases of the maxillary sinus that is the cause. Robertson and Spicer had recoveries following operation for empyema of the maxillary sinus.

Brenner found the sphenoid affected once and the maxillary twice in twenty-five cases, and Harris in nineteen cases found the maxillary affected twice and the ethmoid once. Ricord found only the frontal affected

On the other hand, this theory is opposed by Schech, M. Schmidt, Rosenthal, Wright, Mygind, Zarniko, Hill, Rethi, Jacoby, Hopmann, Gerber, Kafemann, Cholewa, Cordes, Zuckerkandl (anatomic grounds), Habermann, Siebenmann, and Grosskopf (two cases without sinus involvement cured by other means).

I do not consider that disease of the accessory sinuses is the cause of either simple or fetid atrophic rhinitis, although I found it present in relative frequency; 86 cases, in 40 of which the maxillary was affected. Furthermore transillumination and other tests were negative in 290 cases. ,

4. Krause first showed, in 1885, that the principal feature of the disease was to be found in the changes in secretion, namely, fatty degeneraion of the infiltrated cells, hence fetor. E. Fraenkel also maintains that the principal factor in cases of ozena is the atrophy of Bowman's glands, whence the penetration of microorganisms is facilitated, causing fetor. Schoenemann, Grosskopf and Moure hold this view.

According to Habermann, the cause lies in the fatty degeneration of the epithelium of Bowman's glands, as well as of the acinous glands. Rethi and Roe believe in this theory, likewise Jurasz, who regards ozena as an anomaly of secretion. Freudenthal regards xerosis (*i. e.* lack of humidity) as the most important factor, while Sanger believes that it is the diminution (5 to 10 times) of the tension of the expiratory oscillation of the air pressure.

5. The first Volkmann, and afterwards Suchardt showed that the change of the cylindrical epithelium into the flat corneous (the so-called epithelium metaplasia) plays a very important part in the etiology of ozena, fetor being dependent on the decomposition of the corneous substance of the cells. Seifert and Zarniko maintain this opinion, the latter however thinks that the participation of the specific bacterium is necessary. Bayer, Hecht, Capart, Sautmann, Gougenheim, Rethi, Mygind and Bouronilleé hold to the trophoneurotic theory.

Siebenmann introduced in 1900 some modification of this theory on the basis of the mechanical theory, *i. e.,* Suchart's metaplasia, the so-called chemaprosopia (wide face and nasal cavities). Holinger Meisser and Grossherntz suport this view.

Gerber, in 1900, basing his views upon special investigation of 407 cases of ozena, became convinced that chemaprosopia and platyrrhinia (wide face and wide skull) play the most important role. Cholewa and Cordes regard as the cause of ozena the primary changes in the bones (atrophy) analogous to those we see in osteomalacia.

6. The parasitic theory best explains the conditions found in atrophic rhinitis.

The first bacteriologic investigations in ozena were made by E. Fraenkel in 1882. He found two kinds of micrococci and bacilli, regarding one of these (the thick bacillus) as the cause of the fetor. Three years later, Loewenberg of Paris succeeded in cultivating a special form of microorganism which he claimed was specific for ozena, having found the diplococcus (diplobacillus) generally in the form of chains in 16 cases. Besides this ozenacoccus he found two other forms of bacteria. Inoculation, however, was negative.

B. Fraenkel proved the results of E. Fraenkel, but did not acknowledge the specificity of Loewenberg's microorganism. On the other hand, Sicard, Fuge, Bonehevan, Baratoux, Massei, Baurowicz, Lennox-Brown, Hobert and Cornil and Babes have affirmed the Loewenberg discovery.

According to Cornil and Babes, Loewenberg's ozenacoccus is found as large cells, sometimes joined together, 0.5 to 1.0 mikron in diameter. It may be cultivated on gelatin, giving the characteristic odor of ozena. Is is pathogenic for mice—death ensuing in from 1 to 2 days. It has been proved further that Loewenberg's ozenacoccus is identical with Friedländer's pneumococcus (Klamann, Thost, de Simoni, Strazza, etc.).

Paulsen found Friedländer's pneumobacillus in 15 cases of ozena; Abel found it in 16 cases in 1893 and 1895. They claim that in addition to Friedländer's bacillus, another is constantly present, which they call the bacillus mucosus and which is specific for ozena and atrophic rhinitis. Abel's bacillus is 1.25 mikra wide and of varying length; it is stained with methyl blue, carbol fuchsin, anilin fuchsin and anilin methyl-violet, also with Gram. It may be cultivated very well on agar-agar and it is pathogenic for white mice (death from typical septicemia).

Hajek, Dreyfus and Klemperer acknowledge the existence of Loewenberg's ozenacoccus, afterwards proved to be Abel and Paulsen's bacillus mucosus ("Kapselbacillus"). They regard the ozenacoccus and the bacillus mucosus as identical with Friedländer's pneumococcus. The microorganisms, however, are in the secretions but not in the tissues of ozena patients.

Marsano (1890) and Kyle (1894) proved that the bacilidis atrophicae is the most commonly found. In 1900, the Italian writers Bellfanti and della Vedova stated that two forms were found in the crusts: 1. Loewenberg's and Abel's bacillus mucosus; 2. Bacillus pseudodiphtheriticus, which they regard as specific for ozena.

Pes and Gradenigo confirmed this discovery; they found still another kind of bacillus. Auche and Brindel found in 20 cases of atrophic rhinitis, Loewenberg's bacillus mucosus in 20, bacillus diphtheriticus 18, staphylococci 12 and streptococcus 4. De Simoni found the bacillus mucosus of Loewenberg-Abel constantly present; he also found Fraenkel's bacillus foetidus which Baurowicz calls bacillus capseolatus rhinitpneumobacillus of Friedländer and the bacillus typhisimilus were not constantly found present.

Perez in 1900 claimed that the cocco-bacillus foetidus ozaenae was the specific bacterium. Symes found a bacillus very similar to the diphtheria bacillus in 87 per cent of 23 cases examined, so that he regards ozena as a chronic form of nasal diphtheria.

According to Klemperer and Scheier (1901), the ozena bacillus is identical with Friedländer's pneumobacillus as well as with Frish's bacillus rhinoscleromatis. They succeeded in immunizing against the rhinoscleroma bacillus and vice versa. Baurowicz does not agree with this opinion.

Delie and M. Schmidt found the aspergillus fumigatus and penicillium glaucum present in cases of ozena, naturally as parasites.

Although the parastic origin of simple and fetid atrophic rhinitis is the most plausible (Krieg, Cozzolino, Baurowicz, Wright and I hold this view), there are many opponents (Otins, Lombard, Rethi, Longhini, Burger, Siebenmann, Cholewa, Cordes, Hecht and Grosskopf).

LXIV.

LARYNGEAL DISTURBANCES PRODUCED BY VOICE USE.*

(Vascular, cellular, neuromuscular angioma; papilloma; "singer's nodes" in speakers and shouting children; voice fatigue; vocal strain; dysphonia spastica. Principles of prevention.)

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That which is merely "use of the voice" for one person may be overuse for another; hence, both are pertinent to the present discussion. To the singer with failing voice, to the orator with lack of carrying quality, the teacher with recurrent aphonia, the clergyman with spastic vocal contortions and to a host of business folk—dictating correspondents, salesmen, callers and others, the gathering of knoweldge tending to the preservation of the voice is of weighty importance.

The laryngeal disturbances produced by voice use may be grouped under three divisions: vascular, cellular and neuromuscular. Strenuous vocalization excites vascular congestion even in a vigorous larynx, as may be observed in singers after the rendition of difficult roles and in clergymen on the Monday morning following an arduous Sunday. When the larynx is previously weakened by disease, hyperemia is induced by correspondingly less vocal effort, ordinary conversation then sufficing to maintain congestion of the larynx and consequent relaxation of the vocal muscles, as exemplified by a recent case (1) of an incessant talker who, while suffering from acute laryngitis, ran the gamut of sprays and pigments, but permitted no rest to the larynx. Finally, discouraged, and contemplating a change of climate, at great business sacrifice, he consented to a strict adherence to pencil and writing pad, which rest to the vocal organ sufficed to restore his voice in so short a time that it was jocularly referred to as a miracle.

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*A contribution to a Symposium opening a formal Discussion before the Section of Laryngology and Otology of the British Medical Association at Toronto, 1906.

This incident is mentioned to emphasize the well-known but much neglected principle of the need of comparative or even complete vocal rest to an acutely inflamed larynx as a means of treatment. The same principle is of value as a prophylactic measure, the neglect of which was illustrated in the case (II) of an exceptionally forceful concert singer who had been in excellent voice prior to an attack of acute laryngitis during which she persisted in meeting her singing engagements. A few weeks afterwards an angioma of one vocal cord was seen to have developed (Fig. 1). In confirmation of its cause as assigned, I quote from Wyatt Wingrave,[1] "that such angiomata show an increasing vascularity from

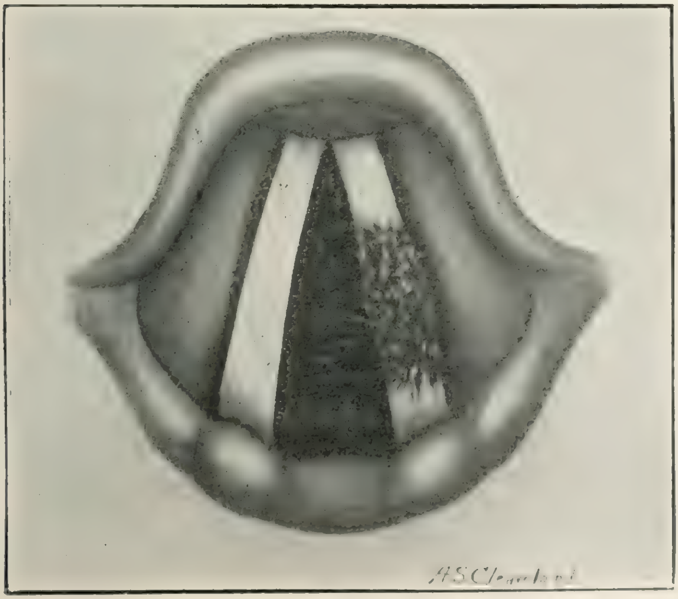

Fig. 1.

a simple hyperemia up to permanent distension and thrombosis." Later in the case, it was found necessary to remove the angioma by galvano-cauterization before the patient's voice could be restored.

Moreover, if there be disease of the accessory vocal organs, e. g., the pharynx, the larynx functionates at a distinct disadvantage and then vascular congestion, muscular atony and even cellular hyperplasia of the vocal cords are liable to result from what may be little more than a customary use of the voice.

Cases III and IV.—A vaudeville singer was handicapped by an unreliable voice; he had laryngeal congestion with atony of the cords accompanied by redness and thickening of the faucial pillars due to retention tonsillitis in the deeply placed bases of imperfectly operated tonsils. A tonsillectomy remedied the whole difficulty, his voice becoming thoroughly competent. On the other hand (Case IV), a country clergyman who continues to endure a chronic retention tonsillitis, while attempting to preach thrice on Sundays and to furnish the music as well, suffers from voice fatigue and many periods of vocal disability.

These experiences being typical, justify formulating a second principle of prevention which is well known to laryngologists, but which is not yet generally recognized, although it is of great economic value to vocalists, viz.: To conserve the voice under maximum use, diseases of the pharynx or nose should be promptly remedied.

Although masters disagree as to what constitutes right or wrong methods of singing, it surely is wrong, in technical phrase, to force the voice, whether in singing or speaking; that is, to compel higher notes than are natural to a given register, to maintain an abnormally loud intensity by reinforcing the blast, to habitually pitch the voice into the falsetto register, or to time overwork the muscular mechanism. To attempt even one's customary role of song or speech at a time of disability either of the larynx or accessory vocal organs is equally a forcing of the voice.

The fact that "singer's nodes" occur also in speakers and others who, by habit or necessity, force the voice in some of these particulars, indicates that the method of singing known as "striking the glottis," although possibly the main cause with singers, as explained by Holbrook Curtis, is not the only wrong or forcing method which is capable of exciting these minute cellular hyperplasiae at points of attrition. All artificiality of method certainly can be excluded by reason of youthfulness, in the following instance of typical "singer's nodes" observed in a boy who did not sing:

Case V.—A boisterous lad of 9 years, described by his parents as an incessant talker and shouter, whose voice always dominates the field of boyish sports, has suffered increasing hoarseness for a year. A small adenoid has been operated simply for exclusion. The laryngeal image plainly discloses a pair of vocal nodules on the edge of the vocal cords at the junction of their anterior and middle third (Fig. 2).

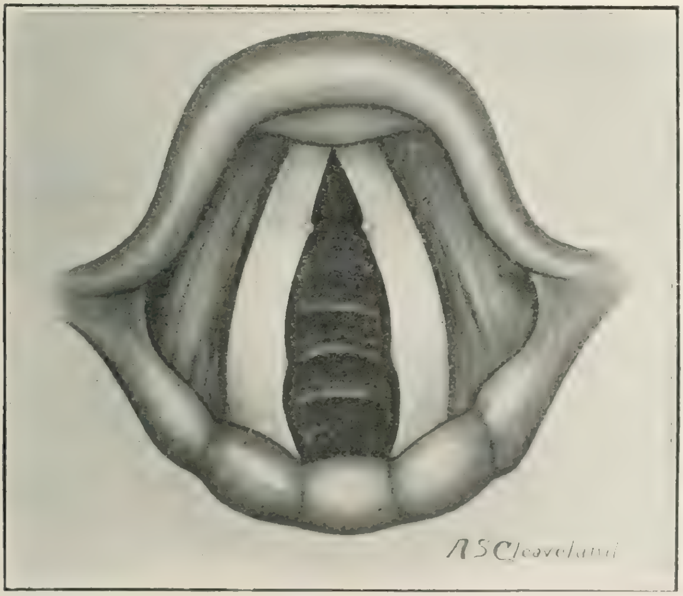

Fig. 2.

The formation of nodes during that sort of forcing of the voice which is impelled by ordinary use of it through periods of disease of the larynx or accessory vocal organs, is exemplified by,

Cases VI and VII.—The former, a choir singer with chronic retention tonsillitis which she disregarded notwithstanding frequent inconvenience until a pair of nodes causing roughness of the voce compelled attention. The outcome was unusually fortunate, as the comparative ease of vocal execution which followed a fragmental tonsillotomy enabled her to continue "in voice" in spite of the nodes, which when last seen had grown smaller as if gradually to disappear. In the latter case (VII) a kindergarten teacher with unsuspected incipient tuberculosis presented an anemic larynx, paretic vocal cords with a pair of nodes, but no other inequalities. Rest to the voice being advised she left the city for six months, and on her return tuberculous pyriform swelling of the arytenoids was present, but the nodes were gone. The inference is that they had formed under the stress of her kindergarten vocal teaching which, for a larynx partly disabled by incipient tuberculosis, amounted to a forcing of the voice.

My observation of papilloma of the larynx in adults serves merely to support the general experience, that voice users are especially subject to it. The inference is the more reasonable since, as stated by Wyatt Wingrave,[2] "hyperemia if sufficiently prolonged or repeated, may result in the histologic dystrophic changes" which constitute a papilloma.

Of course, there are other etiologic factors, but excessive vocalization and consequent hyperemia were the only evident causes in:

CASES IX and X.—Middle-aged gentlemen, one a board of trade operator accustomed to extreme vocal effort on the "floor," and the other a political campaign speaker much in demand at open air meetings on account of his sonorous bass. Each was obliged to relinquish his vocation on account of increasing, persistent hoarseness due to a characteristic papillated neoplasm of the anterior half of the vocal cord, removal of which by intralaryngeal methods eventuated in perfect recovery without recurrence during known periods of ten to fifteen years, although neither thereafter exacted as much use of his voice.

In designating my third division of disturbances of the larynx due to voice use, as neuromuscular, I am conscious of entering upon a phase of the subject of which, even after all is said, our conception of the disorder is still but vague.

Lesions cannot be said to be strictly muscular unless implication of the peripheral nerve endings can be excluded.

However, the rupture of fibres of the internal tensor muscles during their use is certainly a purely myopathic lesion. This sort of functional traumatism is said to happen sometimes to singers, but my own observation of it is limited to the case of a broker.

CASE XI.—Mr. A. R., while vociferating during a panic "on change," felt suddenly a twinge of pain and found himself voiceless. On examination a few hours later the right vocal cord appeared as if it had been struck by a hammer—ecchymotic, swollen, relaxed. The left cord was normal.

Muscular strain from forcing of the voice which affects chiefly the internal tensor muscles—the thyroarytenoidei interni and perhaps the arytenoideus, may be viewed simply as a milder degree of functional traumatism and therefore chiefly a myopathic lesion. In inflammatory paresis, the terminal nerves are thought to participate, therefore it is typically neuromuscular, while in the following notable instances of unilateral double tensor paresis and of dysphonia spastica, the neuropathic element seemed to predominate.

CASE XII.—Rev. J. G. spoke, in part, in the low measured tones of the cultured, but his voice on approaching the several climaxes of a sermon, would suddenly break into the falsetto register like the high pitched enunciation of certain persons in anger but intensified by an enforced blast. It sounded as if it were very wearing to his larynx, and toward the close the exhausted mechanism would weaken, hoarse up and emit jerky and scarcely audible tones, defects which with time, so augmented as to threaten his professional career and to strongly suggest an impending dysphonia spastica. On examination there was noted, pronounced paresis of the left vocal cord, its excursion on phonation falling far short of the middle line. On close analysis it proved to be a conjoined paresis of the external tensor muscle (cricothyroideus) and the internal tensor (thyroarytenoideus internus). The paretic cord and the arytenoid seemed to occupy a lower vertical level in the larynx than the sound one, so that their edges did not meet in the same horizontal plane, which is stated by Gottstein to be a sign of double tensor paralysis. The right arytenoid would override the left, but the picture was not identical with recurrent nerve paralysis, and the usual causes of the lattere were excluded by subsequent observation through a period of ten years. After a few weeks' rest he was able to resume preaching by complying with my advice to restrict the delivery to his more pleasant conversational style. The cord recovered in large measure after some months, but relapsed the following year as he lapsed into the old emotional falsetto style; it again recovered, but three years later again relapsed. During the past six years his more quiet delivery has become habitual, the vocal cord remaining fairly well and just now quite normal in appearance.

Some of the details of the following case of dysphonia spastica I abstract in part from the published report by Dr. John Edwin Rhodes[3], as the patient was observed by myself only informally as a friend, although closely observed and over a long period of time. It is introduced to afford opportunity of comparison with the preceding case and for the purpose of further comment, although I will take occasion to add the termination and to amplify certain phases of it.

CASE XIII.—Mr. C. L. was a noted clergyman who first came under my notice in 1883, when in his 54th year, at which time his voice was beginning to show the earliest definite indications of this phenomenal disease. In opening conversation, he would first strike an attitude by posing his head backward and aside, as if in an effort to facilitate an impeded utterance. The words when they came seemed to be popped out under high pressure and had a disagreeably tense klang, the fewest possible being made to suffice. In preaching he did better, but the pitch was erratic with much falsetto and syllables were sometimes suppressed. Three years later he sought advice, and on examination Dr. Rhodes observed paresis of the right vocal cord and again observed it five months later; but at subsequent examinations, this feature was not noted, probably having been incidentally due to the forcing of the voice in the face of its disability. In this connection I would recall the paresis of one vocal cord, in conjunction with the falsetto habit in the preceding case (XII). In 1893, ten years from the time of my first observation, he was obliged to retire from the pulpit, having become nearly inarticulate in spite of long periods of rest and varied treatments. In attempted utterance, spasmodic contortions of the facial muscles, visible contraction of the neck and chest and congestion of the face would precede by some seconds the jerking out of a few words which came finally, perhaps, in a loud oratorical tone or in a hoarse whisper, or falsetto key, the pitch being quite uncontrollable. About this time, quite a sensation was caused by the announcement that a new treatment had effected a cure and that he would preach the following Sunday, when to my astonishment he did speak distinctly better, albeit far from well. It was subsequently disclosed that the new treatment consisted merely of spraying a cocain solution into the nostrils, that its beneficent effect would endure but an hour and was followed by "terrible reactionary suffering," so that he limited its use to occasions of special church celebrations. During the next ten years he grew worse, notwithstanding an almost continuous silence. Attacks of asthmatic dyspnea conjoined with heart weakness, both said to be of nervous functional, rather than of organic, nature, helped toward a final exhaustion.

What was the exact "laryngeal disturbance" in this case, in what manner was it "produced by voice use" and how did cocain serve to temporarily suspend the disability?

Rhodes,[4] following Mackenzie,[5] ascribed the laryngeal impediment to spasmodic contraction of the tensor muscles of the larynx, which he was able to observe in another similar case, but not in this one, in whom, at the worst stage, the muscular movements as seen in the laryngoscope appeared normal. Semon[6] refers to several cases which presented symptoms identical with the foregoing, in all the worst of which he observed laryngoscopically a spasmodic sphincter-like closure of the larynx on attempts at phonation, indicating in addition a spasm of the adductors. In other words, the larynx under cortical superexcitation overdoes its effort at tone formation, contracts too quickly, too violently; that is, incoordinately with the other elements of speech, ideation, volition, respiration, articulation, hence it fails to emit the tone at the proper psychologic moment—a sort of laryngeal stammer. Like common stammer, it is aggravated by the intuitive accessory muscular efforts of the patient to make himself talk as evidenced by facial and chest contractions, but unlike common stammer, the habit is induced later in life, during the course of years and is acquired chiefly by professional voice users, notably clergymen, through unnatural and enforced methods of address in which the high pitched falsetto register is a factor. The emotional temperament which is a natural characteristic of clergymen, is a predisposing condition in so far as it is prone to find expression in the falsetto key and otherwise to render speech unstable, and if to emotionalism is added, that dyscrasia, which results in asthma, hay fever, nervous dyspepsia and nasal reflexes, the predisposition to dysphonia spastica may be said to be accentuated. Phonetic adduction of the vocal cords is for the purpose of speech in expression of thought, hence the major adduction centres are located in the cerebral cortex, and it is conceivable that under years of emotional impulses leading to high pressure speech, that these centres should acquire a vicious habit of spasmodic violence in action.

The third principle of prevention which I seek thus to establish is, that voice users, especially preachers, should avoid falling into the custom of using high tension speech or the falsetto register, for the reason that it not only does local violence to the neuromuscular mechanism of the larynx, but being an expression of emotionalism, it is liable to habituate the cortical motor centres to an undue excitability, leading to dysphonia spastica

It remains to suggest an explanation of the action of cocain, whose salient effect is local anesthesia, in ameliorating a spasmodic dysphonia which was primarily of centric origin. Two premises may be restated: First, that the fundamental laryngeal spasm was aggravated by accessory spasms, some intuitive, some doubtless reflex, inasmuch as coordinated articulate speech is dependent in part upon a local feeling which guides the play of the delicate muscles through a reflected stimulus. Second, that the cocain only partly, not wholly, ameliorated the dysphonia. It is a fair deduction that by overflow of the nasal cocain spray into the throat, this reflex stimulus was dulled, and to this extent only was the disability ameliorated.

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LXV.

THE REMOVAL OF ADENOID VEGETATIONS THROUGH THE NASAL PASSAGES BY A NEW METHOD.*

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The adenoid curette or ringknife in its many forms is at the present time so widely used for the removal of adenoid vegetation that its employment is understood as a matter of course by most authors when the operation is alluded to. Its popularity is not a proof of the perfect fitness of this implement for its purpose, however, for the wish to complete all surgical procedures with the least expenditure of time and effort is apt to make those methods and instruments the favorites that hasten the performance of an operation and make it as nearly mechanical as possible. For this reason devices with as nearly automatic action, which replace as much as they can the performance of instruments representing extensions of the intelligently acting fingers and hand, have always proved alluring, because they are designed to accomplish with one sweep what would otherwise take time and trouble.

The fault of these mechanical inventions, however, is their lack of adaptability to the varying conditions both anatomic and pathologic apt to be encountered, for while they fit more or less well a certain form of an affection which their designer had in mind when he fashioned them, they apply themselves poorly or not at all to variations differing even moderately from it in structure or surroundings. An example of this kind of device is the popular tonsillotome, which with approximate exactness removes the small class of superficially projecting tonsils which represented typical tonsillar hypertrophy and its anatomic relations to its inventors, but which is an instrument not at all adapted to the much larger genus of partly or wholly submerged enlargements of the tonsils, buried between the pillars of the fauces. The form and mode of action of the ringknife is evidence that its designers had in mind the tonsillotome in constructing it, and with the tonsillotome it shares the fault of a mechanically acting instrument fitted for but one type of a condition presenting widely differing varieties.

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*Read at the Meeting of the American Laryngological Association, Niagara Falls, June, 1906.

The same conception that led to the creation of the tonsillotome, that the tonsil to be removed was always well defined and prominent, seems to have guided the designers of the ringknife, who evidently had a preconceived idea that the type of enlarged pharyngeal tonsil usually encountered forms a circumscribed mass projecting like a faucial tonsil from the vault of the pharynx. An adenoid growth of this kind is, of course, well designed to be planed off with the ringknife, but in my experience this variety is much rarer than proliferations of lymphoid tissue of more extensive and diffuse origin which not only hang from the pharyngeal vault but occupy the posterior wall of the pharynx, both the recessus pharyngei and often the posterior portions of the nasal fossae, in front of the choanal openings. The ringknife could only cut away the central portion of such a collection of adenoid vegetation, while unable to reach the growths on the posterior wall, in the recessus and choanae.

Chiari (*Krankheiten der Oberen Luftwege,* Vol. II, page 119, 1903) states that vegetations low down on the posterior wall of the nasopharynx often and those in the recessus pharyngeus always escape the ringknife, and Johann Fein (*Wiener med. Wochenschrift,* No. 45, page 2152, 1905), himself an advocate of the principle of the ringknife, says that it cannot reach any adenoid growths in the fossa of Rosenmueller (recessus pharyngeus) or those attached to the upper boundary of the choanae in the domain of the nasal cavity. But even where the adenoid vegetations do not grow in the posterior nares, and their attachment begins just behind the septum, the ringknife may fail to reach them because the advancing blunt edge of the blade pushes the foremost fringe of the growths forward into the posterior nasal openings.

Max Goerke (*Fraenkel's Archives für Laryngologie,* 1902, page 278) says: "In using the curette, a portion of the soft adenoid tissue that is wedged in between the instrument and the border of the choanae is pressed into them and gradually expands again afterwards." In addition, the pendulous masses of lymphoid tissues so frequently found hanging from the pharyngeal vault and which slip aside so readily, may avoid the ringknife or be incompletely divided by it so that they remain attached to a pedicle in the nasopharynx. This condition is described by Chiari (*loc. cit.*).

The ringknife possesses another fault which makes it possible for portions of an adenoid growth to escape removal by it. Its blade does not cut in the manner of a knife by slicing, as it is drawn through the tissues, but its edge impinges squarely against the material to be removed, with no sliding motion, so that there is a tendency to scrape over the adenoid masses rather than to cut them off, especially when they are freely movable and the vault of the pharynx is concave laterally so that the edge of the knife does not fit flatly against it.

Fein (*loc. cit.*) describes still another condition that makes a complete removal of the adenoid vegetations with the ringknife uncertain, and that is the limitations of the motions of the handle by the incisor teeth of the lower jaw below and the incisor teeth of the upper jaw, and the hard and soft palate above. The impinging of the handle on the lower incisors limits the motion of the blade forward, so that in cases where the jaws cannot be opened very widely, it fails to reach the anterior part of the adenoid growth, and, as Fein states, the incisor teeth of children have been broken out in the violent attempt to include the foremost vegetations in the sweep of the knife. A long hard palate, aided by a rigid soft palate, also limit the forward reach of the blade, while its backward sweep is interfered with by the incisors of the upper jaw. Curving the stem to permit a good forward reach of the blade interferes with its backward excursion by reason of contact with the upper incisors, so that the straight stem is the best. Fein thinks that he has overcome these obstacles by the bayonet-shaped handle of his curette which carries the shank out of one corner of the mouth. Chiari, however, does not find that he can always operate radically with Fein's instrument, and the bayonet handle adds another bend to an instrument whose motions are already complicated by too many.

A certain type of adenoid growth often encountered by me is also unfavorable for the ringknife. I refer to the tough, firm, fibrous enlargement of the pharyngeal tonsil found in some children and often in adolescents and young adults. The blade is apt to slide over such masses without cutting away more than a small portion of them.

These reasons suffice to show that the ringknife is uncertain in its action, as is admitted by its advocates. It may completely remove the enlarged pharyngeal tonsil in suitable cases. In others it will cut away enough to produce improvement, so that the child breathes better than before the operation, but still has to be urged to close his mouth, and this persistence of mouth-breathing is then spoken of as a "habit." In a number of cases, however, the action of the knife is so superficial that the adenoid growth promptly reforms after its use, and the child is as badly off as before.

The tendency to a more or less complete reproduction of adenoid tissue from its vestiges after operation is described by Max Goerke, who refers to the extraordinary power of regeneration possessed by lymphatic tissue, and says that the remains of adenoid growths may increase in size by exuberant granulation from the cut surfaces until the dimensions of the original vegetations are reached, and that even after a thorough operation by the ringknife, exposing in places the basilar fibrocartilage, portions of lymphatic tissue remain imbedded in the median line which escape the knife and become the source of regeneration of the adenoid vegetations.

The median portion of the growth is especially apt to be thus superficially removed where the pharyngeal vault is concave in the centre as it often is, the ringknife not being able to enter such or other depressions, as its shape fits it only for a level planing off of the hyperplastic tissue. Post-nasal inspection in cases of this kind shows a deeply hollowed centre in the pharyngeal tonsil in the region called the recessus pharyngeus medius by Disse (*Heymann's Handbuch der Laryngologie,* Vol. II, page 24), which would be but superficially if at all reached by the blade of the ringknife. It has been my experience, and that of others, to meet a good many patients whose adenoid vegetations have been completely reproduced after a curettement with this instrument. Fein says that even men of skill, who have performed the operation thousands of times with it, from time to time fail to obtain a result. One failure, however, neutralizes the benefit to the operator's reputation of a number of successful operations, and the numerous relapses following the use of the ringknife have brought adenoid operations in general somewhat into discredit with the public.

In order to be sure of freedom from these annoying returns of adenoid vegetations, it is necessary to extirpate them radically, and any method that will accomplish this, even if it be more tedious than that of the ringknife, is to be preferred to it. As rivals to the ringknife, post-nasal forceps have always held their own, though overshadowed by it, and they are certainly capable of a deeper and more thorough removal of the growths, as they are able to follow the adenoid tissue into hollow places and thus to clear it out of the highest portion of a funnel-shaped pharyngeal vault which would escape the level planing of the ringknife. The post-nasal forceps shares, however, with the latter the difficulty of operating with an instrument with confusing curves that make complicated muscular movements necessary. While with the ringknife the sense of direction of the surgeon is the only guide for the instrument operating hidden in the nasopharynx, and for this reason it has occasionally wounded the tubal prominences, the motions of the post-nasal forceps are to a certain extent under the control of the index finger inserted behind the soft palate, the sense of touch indicating to the beak of the instrument the location of the separate growths. Unfortunately, there is but little room in the nasopharynx for both finger and forceps, and for this reason I have usually found it necessary to withdraw my finger partly before seizing the desired growth, so that a certain amount of uncertain groping for the vegetations also belongs to the post-nasal forceps.

On account of this lack of the exact knowledge of the whereabouts of the jaws of the instrument, I have seen an operator break off a large fragment of the vomer with it, and I have known surgeons to introduce it many times before it could be made to seize a certain adenoid growth. The post-nasal forceps has the advantage over the ringknife that it can clear the fossa of Rosenmueller and also the posterior wall of the nasopharynx fairly well, but, as stated, its curves make it an awkward and somewhat uncertain tool, and by reason of its size and the lack of exact control of its motions, it is not a suitable instrument for clearing the posterior ends of the nasal fossae which, just beyond the choanae, are in my experience often filled with pendulous adenoid tissue.

As rivals to the forceps or ringknife, the sharp spoons cannot come into question, movable masses avoid them, they cannot remove tough fibrous growths, and, as Chiari states, they are apt in places to penetrate the tissues to a dangerous depth.

Besides the oral mode of access to the growths with its complicated curves, there is the direct route through the nasal passages, first adopted by W. Meyer, but abandoned since by all operators for the roomier way through the mouth, as apparently instruments of sufficient size to remove the adenoid growths rapidly cannot be passed through the nares. That this is only apparently the case, I hope to be able to make clear in this paper.

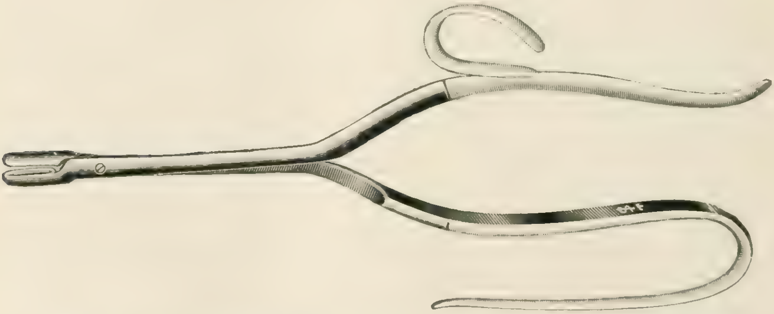

Fig. 1. The pernasal forceps for the removal of adenoid vegetations. The handle of the instrument is so arranged that it can be opened and closed like shears.

The advantage of the nasal route is its directness, so that a straight instrument without curves or angles to confuse the muscular sense can be passed through it, and can therefore be easily guided with exactness. Another factor in favor of this mode of access to the nasopharynx, is the ability to keep the index finger in the nasopharynx to control every step of the operation by the sense of touch and to push the adenoid vegetations toward the operating instrument. The one I employ is a forceps with smoothly rounded beak (Fig. 1), It is a modification of an instrument which in its unchanged form proved singularly suited to the operation in a number of my first cases, Ingal's nasal bone forceps. I have adapted this to the adenoid operation by changes in its construction and an arrangement of its handle so that it opens and shuts like shears.

The jaws of the instrument should have a soft spring temper, as, if hardened too much, they are apt to break off. The uncertainty as to whether I had removed all of the adenoid vegetations in using the post-nasal forceps, first induced me to finish the operation by cutting away such adenoid growths as were left behind by means of the per-nasal forceps described passed through the nose, and as I grew more skilful with it I began to use it for the whole operation and have done so for the past few years.

At first the instrument seems too large to pass through a child's nares without force, but in practice I have never had material difficulty in introducing it through the nostrils of even very young children, the youngest one operated on this way being but 6 months old. The reasons for the ready introduction of such a comparatively large instrument through the nasal fossae of a child are the proportionately large heads of children, giving them relatively roomy nostrils; their broad faces which are accompanied by correspondingly broad nares; the undeveloped state of their turbinated bodies and the elasticity of their growing nasal septa. The latter factor makes it possible to even insinuate the foceps past moderate cartilaginous or slight bony deflections of the septum. The little turbinated bodies of the child with their small amount of bony tissues are readily compressed against the outer wall of the nares.

The mode of operation is as follows: General anesthesia combined with local cocain anesthesia is employed, the child being barely in half narcosis, while a good deal of reliance is placed on the local insensibility obtained by means of a small amount of a 10 per cent spray of cocain introduced into the nostrils when the child begins to go to sleep. When the narcosis is sufficient a gag is inserted, the child is placed on its left side with its left arm behind it, the head is thrown well back, the face is brought clear to the edge of the table and is slightly inclined downward so that the blood can run out of the mouth and nose, the position being one employed for many years by Ingals and others for all adenoid operations and recently exploited as a new method. The finger is then introduced into the nasopharynx, while the forceps, with its side looking towards the roof of the child's nose, is introduced through one of the nares, following the septum and nasal floor, very slight force being needed to make it pass through the posterior naris to reach the index finger in the

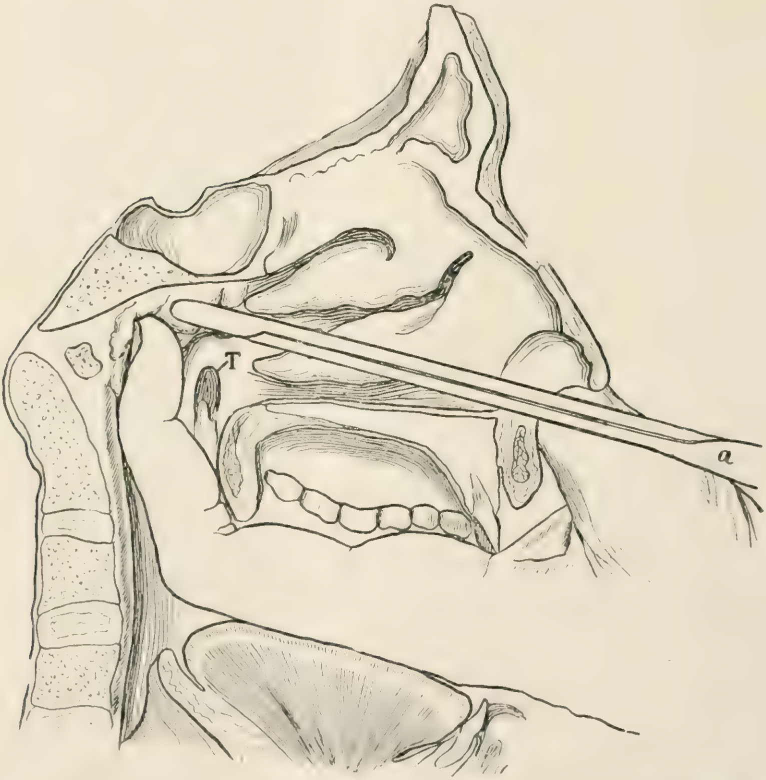

Fig. Lateral view of a sagittal section of the head showing the finger in the nasopharynx guiding adenoid vegetations into the jaws of the pernasal forceps introduced through the nose.

pharynx (Fig. 2). The forceps is then turned so that its broad side looks towards the vault of the pharynx and the jaws are widely opened while the index finger guides as much of the adenoid growth into them as they can hold; they are then firmly thrust into the base of the mass and, with their cutting edges, partly tear and partly cut it off. The forceps is then turned so that its side looks towards the roof of the nose and is withdrawn, the removed piece of tissue being dropped into a glass of boric acid solution.

The procedure is repeated through the same and the other nostril, until no more adenoid growths can be felt with the finger, and the beak of the forceps encounters firm, fibrous tissue over the entire site of the growth. The vegetations in the fossa of Rosenmueller (recessus pharyngeus), those on the posterior pharyngeal wall, those in the highest part of the pharyngeal vault, and the adenoid growths in the posterior nares are all readily reached and torn away. By crowding the beak of the instrument into the growths their removal to the bottom of the lymphoid tissue is assured, and there is no difficulty in entering hollow places in searching for it. The index finger is withdrawn from time to time to give the child a spell of unobstructed breathing. The operation is not lengthy and may be performed in a few minutes, the forceps often taking the greater part of the mass of the pharyngeal tonsil in one bite. The accuracy with which pendulous growths may be guided into the jaws of the instrument is most pleasing, as well as the exactness with which every vestige of adenoid tissue may be removed from the places inaccessible to the ringknife mentioned. The precision with which the forceps does its work is due in part to the constant control of its presence by the palpating ball of the index finger, the finger and the forceps, as it emerges from and recedes towards the nose, constantly meeting in concerted action. An attempt to feel similarly the postnasal forceps while it is seizing the growths is always imperfect, as the presence of the instrument and finger in the nasopharynx at the same time is a hindrance to both, especially in small throats, and where control by palpation is attempted at all it has usually to be done with the nail and not the ball of the index finger.

One of the chief advantages of the per-nasal forceps over the post-nasal one and over all other instruments operating by way of the mouth is that it pushes the adenoid growths out of the posterior nares, making them accessible and attacking their foremost part where the obstruction to nasal respiration is greatest, while the tendency of the post-nasal instruments is to crowd the vegetations forward into the choanae beyond their reach. This became strikingly evident to me in the cases where I finished operations begun with the post-nasal forceps by means of the per-nasal one, which pushed out of the posterior nares and removed astonishingly large remains of adenoid tissue after I had deemed all of it taken away with the post-nasal forceps.

The tubal prominences in the operation through the nose are not in danger, as they may readily be felt and protected by the index finger. As in all things, experience is required to acquire the technic of the operation I have described and to learn to perform it rapidly, but I have had no difficulty in teaching the method to my assistants and pupils. I have never known of the return of the adenoid vegetations after this mode of operation, and the children all cease their mouth-breathing after a few days to a week. Though I do not deny that a true mouth-breathing habit may exist in some cases in children possessing a free way for nasal respiration, and that in others deformities of the jaws misplacing the teeth may prevent closure of the lips without effort, as a rule a child that continues to use his mouth for breathing after an operation for adenoid vegetations has not been completely relieved of them.

Excepting in one case, I have never seen injury to the nose from the operation, at the most a moderate reactionary swelling of the mucosa partially occludes the nares for a few days, and this slight nasal irritation is a small price to pay for the assurance that the removal of the adenoid growths has been radical. In the one case referred to, a small adhesion formed between a lower turbinated body and the septum as a result of abrasion of the mucosa by a roughened projecting screwhead at the lock of the forceps. To avoid a repetition of this accident, I have sunk the screwhead and also have had the sharp corners of the jaws below the lock rounded off. I have never had unusual hemorrhage during the operation and have had no post-operative bleeding. In adults and older children, it may be performed without general narcosis with merely cocain anesthesia, pure cocain flakes being conveyed by a minute moist swab through the nose and post-nasally into the nasopharynx and applied along the route of the forceps. Done in this way, the operation is not especially painful, but nevertheless requires courageous patients.

No after-treatment is required. Enlarged tonsils may be removed as a preliminary.

The procedure I have described differs so radically from the traditions that I expect it to meet with little favor; at least, at first. In its defense, I can say that of those who have seen me operate by this method, all seem convinced of its merits and my pupils are its enthusiastic advocates. The instrumentarium is exceedingly simple and inexpensive, and I hope that a few will make use of it at least to supplement the instruments they are accustomed to, where growths unreachable by the ringknife need removal from the fossa of Rosenmueller, the choanae and the posterior pharyngeal wall. I also suggest its employment where a relapse after a curettement indicates the use of another method.

LXVI.

PRESIDENT'S ADDRESS BEFORE THE AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, KANSAS CITY, 1906.

By J. E. Logan, M. D.

KANSAS CITY.

It has always been the custom of this Association to hold its annual meeting in the home town of its presiding officer; but never before in its history has it been called upon to cross the eastern bank of the Mississippi River, and venture so far to the westward. The honor you have done me, gentlemen, is so much beyond my deserts that I will not even attempt to express my appreciation of it, but shall merely add to the words of welcome you have already heard, my personal heartfelt thanks for your kindness and courtesy, and my sincere hope that nothing will occur during your stay with us that will cause you to regret the unusual effort you have put forth in coming.

The holding of the twelfth yearly session of the American Laryngological, Rhinological and Otological Society in Kansas City not only marks an epoch in the growth of this young metropolis—of which we its citizens are so fond and possibly a trifle too proud—but it registers a long step forward in the development of our particular corner of the great field of medical science.

Scattered all over this wide Middle West, are scores of men, co-workers with us, bright, energetic young fellows, well equipped in the main and alive to their duties and their responsibilities who, nevertheless, are so deeply engrossed in the daily routine, so busy with the hard grind of general or special practice, that they cannot—or they think that they cannot—break away each year long enough to attend a medical convention in a distant city. They can come to us here, however, and to such men the presence of so large a body of distinguished specialists, of so many successful students of those same knotty problems with which they themselves are constantly wrestling, cannot fail to be a present inspiration and a permanent benefit.

The germ of enthusiasm is communicated most swiftly and unfailingly by personal contact. It is one thing to read in a professional journal a long technical article reporting the results of a series of tedious experiments, or to glance hastily through a pithy paragraph heralding a discovery, that may or may not be revolutionary in its consequences; it is another and a very different thing to listen to the voice of that same patient investigator as he rehearses, step by step, his cautious, but no longer tedious processes; or to catch fire from the spark that lights the eye of that one who has captured another of Nature's guarded secrets, or who has come out victorious in battle with another of humanity's dreaded foes.

So potent a factor do I regard this face-to-face encounter between soldiers fighting under the same banner, that I shall be as much surprised as disappointed, if many new names are not added to our roll-call as the direct result of this convention. Should that be the case, virtue, which is always a sufficient recompense, will not be its sole reward. These fresh, unworn recruits will not come to us empty-handed. They will give as well as receive. The infusion of new blood into our veins will necessarily show itself sooner or later in the greater vigor and activity of our whole body. We have heretofore largely increased our usefulness in this way, and perhaps no greater good has resulted—indirectly—from this organization that this opening up of new spheres of influence by means of our annual change of meeting place.

In reviewing the work of this Society during the few years of its existence, I find so many reasons for satisfaction—with ourselves—that I should not dare recite them all even right here in the family. I shall presently mention very briefly one or two things that seem especially to invite self-felicitation, but before doing so I must ask your consideration of some matters of practical business.

In pursuance of our policy of encouraging first-hand investigation within our membership, we have, as you know, recently set apart the sum of five hundred ($500) dollars, and have authorized the judicial committee to select from the material annually submitted to it, the article, monograph or volume which in its judgment shows most original research, and reimburse the author for the actual cost incurred in getting out his work.

This is a move in the right direction, but in my opinion the fund is insufficient for the purpose, and should as soon as practicable be substantially increased. With more money at their disposal, the judges could exercise some discretion as to the amount of reimbursement required in each case; and, besides putting a more liberal interpretation upon the rigid letter of their instructions, they could enlarge considerably the scope of the competition.

It goes without saying, that I am not proposing to pay the successful competitor for the time and labor expended. I should as soon think of suggesting that he be paid for the clear brain and the unselfish purpose that made that time and toil fruitful. That would be neither possible, nor in this case desirable. The pure joy of achievement, the calm pleasure that comes with the consciousness of a worthy task nobly done is—if not reward enough for any man—certainly reward enough for any member of that profession whose proudest distinction is that it puts the welfare of all so high above individual profit. But while I am far from wishing to dangle a money prize before the eyes of our ambitious and gifted brethren, I do not forget that on this particular planet at this particular stage of its social evolution, money is a very necessary evil, and doctors are not invariably multi-millionaires.

Scientific experiments ordinarily demand costly apparatus, and much material, and occasionally the expense entailed is so great as to be practically prohibitive. It is scarcely fair that he who so freely pours his best into the common treasury should be expected to do so at an actual financial sacrifice. We who share the benefit should in some measure share also the burden.

Closely allied with the subject of the fund is that of the Library. This is such a recent addition to the resources of the Association that it is entirely possible that some of you may be as yet unaware that we have a library to discuss. If that be the case, it gives me great pleasure to report to you that through the generosity and untiring efforts of Dr. Curtis and Dr. Harris there has gathered the nucleus of what we hope will in time grow into a complete and in some respects a unique collection of the latest and most valuable literature upon our especial subjects.

Henceforth it will be not only our privilege, but also our duty both as an organization and as individuals to foster in all possible ways this new enterprise. It may be made, and it should be made, a repository of all published matter bearing upon Rhinology, Laryngology and Otology, and as such will be of invaluable assistance to any one wishing to keep himself fully abreast of the times.

Besides devoting much time and trouble to getting together the books, pamphlets and periodicals composing this collection, Dr. Curtis has set apart a room in his residence as a temporary home for it; and the matter now on hand is, I understand, being catalogued and indexed so as to be available for reference purposes to fellows of the Society.

Later on it should be possible for any member, no matter how far he may live from New York, to procure data by mail on the subject he happens to be investigating. But of course, before we can expect such practical results, we must relieve Dr. Curtis of the burden he has so unselfishly assumed, and ourselves provide permanent quarters for the collection. We shall then need a librarian whose duty it will be to facilitate to the utmost the use of the books, and who shall moreover be competent to make the necessary notes and excerpts for the benefit of those who must avail themselves of the resources of the library at long range.

There is one other project that I feel impelled to put before this convention. It has been often in my mind during the last few years, and now that I have such an excellent opportunity I cannot resist the temptation to spring it upon you.

It does seem to me, gentlemen, that the time has arrived for the American Laryngological, Rhinological and Otological Society to have an organ of its very own—a journal devoted exclusively to the special interests which it represents. I see nothing impracticable in such an undertaking, nor any reason why it should not mean for us as much as The Journal of the American Medical Association does to that body. We have a number of men who could edit such a periodical with distinction to themselves and to the Society; and surely there would be no lack of material. The list of contributors would include the most notable names in our ranks in Europe as well as in America, and such a periodical would be the natural and most efficient means of keeping us in touch with the latest discoveries in medical science, and the newest achievements in our own and cognate branches of surgery. It would present in a concise, readily accessible form reliable information which is now scattered broadcast through various publications, domestic and foreign. It would in consequence be a great time-saver, and that is no small merit in this over-worked age. Few of us have the necessary leisure to search the mass of periodicals for the grains of wheat that lie hidden in the bushels of chaff.

Such a journal would immediately take its place as a recognized authority, and would be read by every laryngologist, rhinologist and aurist from the Atlantic to the Pacific. They could not afford to ignore it. I am firmly convinced that it would be self-supporting from the start, and as it would be the natural channel for the appearance of the Society's Transactions, it would save us cost of their separate publication which is no insignificant item in our yearly budget. Professionally we have all to gain, and financially there is little risk of loss in inaugurating this new enterprise. Now is the time, and Kansas City (which is a town of beginnings), is precisely the place to bring forth the young stranger for whom I predict a long, honorable and most useful career. I earnestly urge the matter upon your favorable consideration.

It is fortunate for us that there remains, and will always so, much to be accomplished that there can be no danger that the medical profession will be forced to stand still for lack of new worlds to conquer.

On the long, hard road "that winds uphill all the way" every height gained brings more plainly into view the limitless range of peaks yet to be scaled. Nevertheless, the knowledge that we have mounted so far gives us new strength and added courage to press on, and it is well to pause occasionally long enough to measure the distance over which we have lately come.

Twelve years ago, for instance, the science of Otology was, if not in its puling infancy, at least in its backward childhood. It had been traditionally associated with Ophthalmology, and as a result of this incongruous alliance, it had made little or no progress. This Society broke the hampering bonds, and for the first time recognized the natural affinity existing between Otology and Laryngology and Rhinology. Once started on the true road, aural surgery has since gone forward on seven-league boots. We may safely affirm that in no branch of the medical professional has such phenomenal advance ever been made as during the last decade in the surgery of the ear, the brain and the sinuses. And without boasting we can say that on this double-quick forward march the members of the American Laryngological, Rhinological and Otological Society have always been found in the van. No other organization of its age has such a record for original work, and no other has a more earnest, devoted and courageous band of workers. It is largely owing to the labors of men in our association that American surgery holds the place it now occupies in the eyes of the world. It is no longer necessary as it once was for a young man seeking the best training to go abroad to study, although the added experience and the wider outlook still make such a course advisable when circumstances permit.

But nowhere on the globe can be found more skilful surgeons, more daring investigators or more capable, high-minded and self-sacrificing students of the great problems of biology and pathology than we have right here in our own ranks.

The rapid advance we have made is, however, necessarily attended with dangers. The pitfalls and hidden obstacles that lie in wait for the cavalry corps that attacks the redoubt in a sweeping gallop are no serious menace to the slow-moving infantry that plods after them. Like the famous general of old, the advance guard now and then marches up the hill and then marches down again with no tangible result except perhaps to send the pendulum swinging in another direction; and for this reason it may not be out of place to sound a note of warning.

Courage is a great and a glorious thing. A man who is not brave enough to take all unavoidable risks is not worthy of attaining a great goal. Courage, real courage, examines all sides of a question; it counts the cost carefully, and having once decided it goes forward without haste and without rest to a definite clearly foreseen end.

But between this true and wise courage, and that reckless daring that plays with human life as with a child's toy, that proclaims every operation a success no matter what becomes of the patient, there yawns a gulf as wide and as deep as that which divided Lazarus and Dives.

It sometimes requires less courage to operate than to refrain from operating. It is not always easy for the surgeon to wait until he is at least approximately sure he is right before he goes ahead. So many marvelous things have been done, so many marvelous things remain to do, that our own eagerness aided frequently by the ignorant over-confidence of the patient and of his anxious and well-meaning friends occasionally tempt us to radical measures that we live to regret.

Do not misunderstand me. I am not opposing progress. I am not advocating a return to the dark ages of surgery, when, for example, the bare thought of opening an abscess in the brain would have frightened both the operator and the invalid into a premature grave; but I am pleading for conservatism in capital operations. Not all movement is forward motion. There is such a thing as going backward; and it is quite possible to keep up a show of violent activity by simply marking time.

Let us then first make sure that we are progressing, and then let us temper progressiveness with judgment. We are not primarily a band of scientists privileged to experiment on human beings to gratify a learned curiosity. We are first and foremost surgeons, and our paramount duty—I am not sure that I ought not to say our sole duty—is to relieve our patient.

With this word of caution, and conservatism comes natural to the man who was born south of the Mason and Dixon Line, I will close and give space to others.

Gentlemen, allow me to thank you for your courteous attention and to express once more my pleasure at seeing you here.

LXVII.

THE DIFFUSE HYPERPLASTIC LARYNGITIS AND PHARYNGITIS OF CONGENITAL SYPHILIS.

By A. Brown Kelly, M. D., D. Sc.,

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GLASGOW.

The various forms of hyperplasia found in the pharynx or larynx in late hereditary syphilis may be conveniently classified as follows: (1) Hyperplasia associated with ulceration: frequently seen as thickening at the periphery of ulcers or scars. (2) Hypertrophic granulations and papillary excrescences, which may or may not be preceded or followed by ulceration; the condition is oftenest seen on the epiglottis and resembles lupus. (3) Tumor-like hyperplasia. (4) Diffuse hyperplastic infiltration.

I intend to deal here with the last-mentioned variety almost entirely. Owing to the lack of reference to the subject in textbooks on diseases of the throat, an account of the following case may be instructive.

Harry —, aged 7 years, was sent to me in August, 1900, by Dr. J. P. Riddell. Since March of the same year, his breathing had been noisy, especially at night; his speech had become slightly indistinct although the voice remained clear; there had been occasionally scanty epistaxis; and his general health, previously excellent, had suffered considerably. He had no pain or difficulty in swallowing, and there was no history of his having had sore throat.

I found the boy well grown but thin and pale, breathing rather rapidly, with loud stridulous inspirations. On examining his pharynx, the uvula—excepting a small normal portion at the tip—and the mesial part of the soft palate were seen to have undergone marked uniform thickening. The infiltrated area was smooth, pale, and of a hard fibrous consistence, so that the enlarged uvula formed a firm unyielding mass. There was no ulceration. The pharynx was not otherwise involved.

The nose and nasopharynx were normal. The epiglottis was also normal. The arytenoids, on the other hand, were greatly changed and formed two large, pale, smooth masses, which pressed closely together and moved but slightly on phonation and deep inspiration. The upper orifice of the larynx was thus reduced to a small triangular opening between the infiltrated arytenoids and the epiglottis, and was too small to allow of inspection of the parts below. None of the stigmata of congenital syphilis was present.

The condition in the pharynx and larynx was regarded as syphilitic: a view which found confirmation in the family history. The child's father had contracted syphilis, but the mother had never manifested any signs of the disease. She had had two miscarriages and eight children, five of which died in infancy. All the children when a few weeks old had presented eruptions, some of which, e. g., pemphigus, were undoubtedly specific. My patient when an infant had ailed intermittently, and mercurial inunctions and grey powder had been administered for "spots" on his skin. Since he was six months old, however, he had been well until the onset of the laryngeal symptoms above described.

Mercurial inunctions and subsequently iodid of potassium were prescribed with the result that his general health improved, and his breathing became slowly less noisy. Six months after coming under observation, the respiration was quiet, the infiltration of the palate was much less, and the entrance to the larynx was slightly freer although considerable stenosis still persisted, as is shown in the drawing (Fig. 1.) which was made at this date. The patient was examined two years later and the appearance were practically unchanged.

After he had been two months under treatment, the greater part of the enlarged uvula was removed, and submitted to Dr. A. R. Ferguson, now Professor of Pathology, Medical School, Cairo, whose report on its microscopic structure follows: "The uvula (submitted entire) was divided by a median longitudinal incision, fixed in saturated solution of corrosive sublimate, and embedded in paraffin in the usual manner. Sections were prepared parallel to the cut surface and included the entire uvula. The nuclear stain employed was Mayer's haemalum, and eosine, eosine and orange, and Von Gieson's fluid were used in combination with this. The microscopical characters are as follows:

"Low Power.—The epithelium is increased in thickness. There is a well-marked keratinous layer which at parts has quite a corneous character. No stratum lucidum is visible. The papillæ of the Malpighian layer are in the main well preserved and the columnar layer of cells proper to this layer is observed throughout. The basilar membrane is well seen at parts, and where invisible is rendered so by inflammatory changes beneath. Practically the whole sub-epithelial zone of tissue is occupied by a very cellular granulation tissue in which at parts dense collections of leucocytes apparently are visible. In this zone, which does not extend very deeply, the vessels are of small size and very numerous. The more central portion is composed largely of a fairly fibrillated and rather scantily ulcerated nucleated connective tissue, in which are visible the lumina of vascular channels. These latter are less abundant here than in the sub-epithelial inflammatory zone noted above. They are in every case either surrounded by, or in close lateral relation to, dense clusters of cells possessing the characters of those seen in granulation tissue. There is a considerable amount of mucous gland tissue present towards the base of uvula. The acini, which appear normal in every respect, are lined by columnar cells with completely distended or ruptured walls. The irregular cellular infiltration noted round the vessess is entirely absent from the interstitial tissue of the glands."

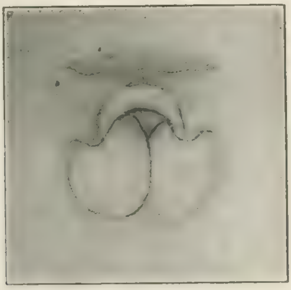

Fig. 1.

"High Power.—The corneal layer is relatively broad with elongated narrow nuclei; the stratum granulosum is reduced to a single layer with the characteristic appearances. The cells of the Malpighian layer are somewhat compressed and where the epithelial covering is thinnest are interrupted by leucocytes apparently making their way towards the surface. The tissue immediately beneath possesses generally throughout the characters of a fairly vascular granulation tissue, the degree of cellularity of which varies very considerably. In the less cellular parts, the oval or spindle-shaped cells met with in organizing connective tissue are comparatively abundant. In the more richly cellular portions, the nuclei are small and rounded and more resemble those of lymphocytes. The ground substance of this tissue is either homogeneous or very faintly granular and shows no fibrillation. The sub-epithelial zone in which this tissue occurs is nowhere extensive and passes rather abruptly into richly fibrillated and rather sparsely cellular connective tissue. The cellular areas around the vessels in the central parts of the uvula consist of leucocytes and young connective tissue corpuscles with a scanty and finely fibrillar intercellular matrix. There are nowhere appearances of arterial thickening or of endarteritis."

It should be mentioned that the microscopic appearances just detailed resemble those of subglottic hypertrophic laryngitis, and of sclerotic hyperplasia, as pointed out in a paper on the latter affection published in the *Lancet,* 6th of April, 1901.[1] The microscopic examination of the uvula from the man with sclerotic hyperplasia differed from that of the child's uvula in the above case of congenital syphilis in the following respects: 1. The epithelial covering in the man's uvula was compressed, thin but dense, and without papillæ; in the child's it was increased in thickness, and the papillæ were marked but not exaggerated. 2. The granulation tissue zone beneath the epithelium in the adult was more irregular, less cellular, and with less inflammatory elements. 3. Slight whorling of the connective tissue surrounding the arteries in the man's uvula. 4. Marked inflammatory infiltration of the glandular interstitial tissue in the man's uvula, which was completely absent in the child's.

The features worthy of special attention in the case of congenital syphilis reported above are: 1. The uniform and symmetrical character of the infiltration. 2. The absence of ulceration. 3. The tendency of the infiltrated region to become edematous and produce more or less laryngeal stenosis. 4. The persistence of the hyperplasia in spite of anti-syphilitic treatment.

In several of these respects, a contrast is presented to the appearances usually observed, and the course commonly followed in hereditary syphilis. I have been able to find records of only a few similar cases which, given in an epitomized form below, may assist in the conception of the clinical picture. The first three were reported by J. N. Mackenzie[2] in an excellent monograph on congenital syphilis of the throat under the term chronic interstitial laryngitis.

1. Boy, aged 15 years, suffered from dysphagia, hoarseness and slight dyspnea. Considerable destruction was found in pharynx due to ulceration. Epiglottis was greatly thickened; and aryepiglottic folds, arytenoids and venticular bands were swollen. No signs of ulceration and no cicatrices. The uniformly thickened laryngeal membrane presented a dull, lustreless, pale-red appearance. Three months later the hyperemia was less but the hypertrophy remained unaltered.

2. Girl, aged 12 years, presented ulceration and necrosis of palate, and cicatrices in pharynx. The mucous membrane of the larynx was uniformly thickened and hyperemic. Three months later the ulceration was healed and patient cured. The thickening of the laryngeal membrane remained unaltered, but its congested condition had disappeared.

5. Syphilitic child. Ulceration of tongue. Uvula and greater part of soft palate destroyed. The mucous membrane of the entire larynx was uniformly hypertrophied and presented a dirty, yellowish-red appearance. The vocal cords were swollen, sluggish and congested. The child was rapidly improving under iodid of potassium.

4. Jacob's[3] Case. A child from a fortnight after birth presented manifestation of congenital syphilis. When about five months old, cough and huskiness set in, and larnygeal obstruction soon supervened demanding tracheotomy, but the child died. At the necropsy no marked change was observed in the upper compartment of the larynx, but below the cords the lumen was reduced to a mere chink by swelling and thickening of the mucous membrane, which extended about three-quarters of an inch downwards. Microscopically, the thickening was seen to consist of a mucous membrane greatly thickened by interstitial deposit of connective tissue, as well as

by hypertrophy of the gland tissue. There was an entire absence of ulceration.

5. Eröss's[4] Case. Child, aged 3½ years. Hypertrophy of mucous membane of entire larynx. Epiglottis depressed, thickened to three or four times its normal, and horse-shoe shaped. Aryepiglottic folds and left false cord greatly thickened, the latter bulging at the middle and dark red.

6. Compaired's[5] Case. Boy, aged 5½ years, had had hoarseness, cough and noisy respiration for over five months. On several occasions suffocation threatened. In the larynx, there was a generalized hypertrophic state of the mucous membrane affecting chiefly the aryepiglottic folds.

The above reports show that the laryngeal appearances of diffuse hyperplasia warrant special attention on account of their rarity, and their liability to be wrongly diagnosed. Errors are especially apt to arise when, as in my case, no other sign of congenital syphilis was present, and the condition was acute.

It must be remembered, however, that while it may be convenient clinically to distinguish between circumscribed and diffuse hyperplasia, with and without ulceration respectively, no strict classification of this kind is possible, for the various conditions may be associated or may pass into one another. Thus, in my patient the use of the laryngeal mirror sometimes caused minute hemorrhages from the thickened palate, a fact which taken in conjunction with the microscopic aspect of the uvula showed that ulceration of the surface might readily have occurred.

The association of diffuse hyperplasia with superficial ulceration has been observed by Semon[6], who was probably the first to direct attention to this particular manifestation of congenital syphilis of the larynx. In 1880 he showed, at a meeting of the Pathological Society, of London, the larynges of two brothers who had been subjects of congenital syphilis, and had died within three weeks of each other of the same acute complication of the primary disease, namely, acute laryngeal edema. In the case of the older boy, aged 5¾ years, the entire larynx presented a general hyperplastic change with superficial ulceration. The hyperplasia was especially marked in the epiglottis, the aryepiglottic folds and the interarytenoid fold; there was also acute edema of the epiglottis and aryepiglottic folds. The chronic thickening and acute edema caused the opening into the larynx to be so narrowed as scarcely to admit the tip of a lead pencil. The true and false cords were destroyed by ragged ulcerations. The larynx of the younger boy, aged 3½ years, presented acute edematous infiltration of the vocal cords, ventricular bands and interarytenoid fold. The aryepiglottic folds were less infiltrated, and the epiglottis had nearly escaped. In both cases there were numerous shallow ulcerations of the mucous membrane in the interior of the larynx, but in the younger boy the chronic changes were less, and the acute ones more developed than in his brother.

Further, the hyperplasia may at any time become the seat of a gummi, or circumscribed hyperplasia may be present in one part of the larynx and deep ulceration or cicatrization in another. A comparatively large number of such cases has been described and collected by J. N. Mackenzie, Strauss[7] and others. The accompanying drawing (Fig. 2) depicts the permanent laryngeal appearances in a case falling under this category. The upper part of the epiglottis is gone, the remainder is much infiltrated and scarred; the posterior wall is irregular; a tumor-like projection passes from the right false cord and prevents the perfect approximation of the vocal cords. Specific treatment produced no effect on the size of this outgrowth, and the resistance offered by its hard texture was such as to render impossible its reduction by ordinary laryngeal cutting forceps.

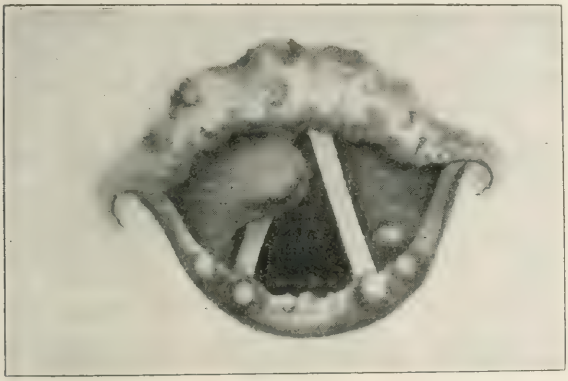

Fig. 2.

Congenital syphilis of the larynx must be regarded as an affection of extreme gravity if one may judge from the large proportion of reported cases that has died of suffocation or been rescued from death by tracheotomy. Even after the patient has been under treatment and is comparatively free of danger, edema may rapidly develop and cause suffocation. Sturge[8] lost a boy who had been treated for seven months with benefit. One day the child was on his way to the hospital when a somewhat violent gust of wind seemed to take away his breath (spasm) and he died before assistance could be rendered. Diffuse hyperplastic changes in the larynx are probably those that menace life most. Such at least, is J. N. Mackenzie's opinion, and support is afforded it by the death of Jacob's, and of both of Semon's cases, and by suffocation threatening several times in Compaired's patient and my own. The latter on one occasion was sent hurriedly to the infirmary to have tracheotomy performed, which was rendered unnecessary, however, by the subsidence of the edema.

In a number of the cases recorded of congenital syphilis of the larynx, the pharynx has also been involved. As a rule, there had been ulceration leading to destruction of less or more of the palate, uvula, faucial pillars, etc. In a few instances, however, the manifestations resembled rather those in my patient. Thus, in one of Semon's patients the uvula was thickened and congested, and in Strauss' first case the uvula was thickened and presented a superficial plaque-like ulceration.

In tertiary syphilis, hyperplasia may occur secondary to ulceration as granulations, papillary excrescences and tumor-like formations, which may or may not be preceded by ulceration, and as subglottic hypertrophic laryngitis. On the other hand, the diffuse symmetrical hyperplasia of congenital syphilis involving the supraglottic regon has no counterpart in tertiary syphilis. This would seem to form a distinction between acquired and inherited syphilis which possibly arises from differences in the tissues of the two classes of subjects.

It should therefore be kept in view, that a symmetrical hyperplasia of the laryngeal mucous membrane, unaccompanied by ulceration, may appear as a manifestation of congenital syphilis in a patient presenting no other sign of the diathesis, in whom only slight improvement is obtainable by anti-syphilitic treatment.

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LXVIII.

COUGH IN DISEASES OF THE RECURRENT NERVE.

By Prof. Gerard Ferreri,

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The pathologic physiology of the recurrent nerve will, for some time to come, give many occasions for animated polemic discussions, until anatomic studies and experimental clinical researches decide conclusively whether this nerve is exclusively motor or of a mixed nature. It is owing to a work of Burkhardt, which appeared in 1868, that the dispute again arose, and the number of those who believe that the recurrent nerve is made up of centripetal and centrifugal fibres has greatly increased, their opinion being backed by numerous experiences (Pflüger, Valentine, Krause, Réthi, Masini, Onodi, etc.).

It would be too difficult a task for me, at this moment, to give a decisive judgment on the subject, not having had conclusive personal physiologic experience. I do not think it labor lost, however, to put forth some objections with regard to the motor nature of the recurrent nerve, basing my claims upon some clinical observations of patients suffering from aortal compression of the recurrent nerve. The principal symptoms upon which we base our diagnosis of this lesion are those of mobility, as revealed by the laryngoscope, such as clonic spasms, contractions and the paretic and paralytic state of the cords. But these are not the only symptoms, and among others we must reckon with two phenomena, which are not very rare, viz., pain and cough.

Thus far, physiologists and the clinicians have studied chiefly the motor rather than the sensitive innervation of the larynx.

The experiments upon the recurrent nerve producing when cut or lacerated a Wallerian degeneracy of the nervous fibres and cellular modifications in the bulbar centres (chromolysis), established that it is exclusively motor, that the innervation of the larynx comes from the bulbar roots of the vagospinal nucleus, and that, in short, the bulbar centre for the larynx is found in the dorsal vagospinal nucleus of the pneumogastric.

According to the most recent researches in anatomy, only the motor fibres of the pneumogastric, arising from a long grey mass situated in the bulb (dorsal motor nucleus), would play a part in the constitution of the trunks of the recurrent nerve while the spinal nucleus (eleventh pair) would take no part whatever in laryngeal innervation. Admitting as already proven that the trunk of the recurrent nerve is only motor, the different diseases which can attack it (i. e., rheumatism, compression, neuritis) should yield nothing but a very simple symptomatology, depending upon the irritation, or upon the paresis or paralysis of this nerve.

The exclusively motor nature of the recurrent nerve therefore, can give an almost mathematical explanation of the mechanism of the different positions of the vocal cords in cases of lesions of this nerve, as we see by the reflections on the laryngoscope. But such is not the case when we wish to account for the other symptoms which sometimes accompany lesions of the recurrent nerve, such as the phonetic and respiratory disturbances, and those which sometimes precede the lesion or which may be the only symptom found, e. g., the cough.

It is in such cases that the question becomes a veritable Gordian knot.

With regard to the pain, in the larynx as in any other part or organ, it is anything but a precise diagnostic sign; rather, all pain is purely a subjective phenomenon, whose gravity it is impossible for the physician to rate or estimate; it is extremely difficult to determine how much of this troublesome sensation is due to the disease and how much is due to the greater or less impressionability and susceptibility of the patient.

Some there are who wish to attach too much importance to pain as a symptom. It is true that very often it is the symptom of the disease and the stimulus which leads the patient to consult a physician. It is equally certain that now and then it is the symptom which most troubles the sufferer and for which he seeks a speedy cure; but there is a great difference between considering this as a pathognomonic sign of the gravity of the disease and of wishing to establish it as a positive diagnostic element of disease of the larynx.

Pain is entirely individual, and each one feels it according to his special physical constitution; what may cause unutterable suffering to one person may easily be borne by another. Munnkoppf thought that pain could be diagnosed objectively, basing his opinion upon the variatious which pain produces in the frequency and rhythm of the arterial pulse; but such a phenomenon is not constant, being more or less accentuated according to the circumstances which render the individual more or less sensible to pain; therefore, experience is, in the same manner, useless, for it cannot succeed even in detecting simulation, inasmuch as the psychical tension, in which the simulation is found at the moment of examination, is of itself capable of producing Munnkoppf's sign, in which case it would truly be positive without any pain, and so every attempt at an objective diagnosis of pain is useless.

Pain is entirely subjective, and we must content ourselves with making a relative estimate of it, for there are no sphygmograph and no spirometer that can record it; each one feels and suffers in his own individual way and science can establish nothing positive about it. And so from a clinical point of view, this is a great loss, since in many cases it would be sufficiently interesting to be able to establish something definite as regards this diagnostic element in affections of the larynx.

Often the slightest affections of the throat occasion the most acute pain, while, generally speaking, grave affections (such as syphilis, tuberculosis, cancer) and all kinds of compression of the recurrent nerve, continue to run on without pain, in the majority of cases.

To return now to our discussion of the laryngeal disturbances caused by aortic compression of the recurrent nerve. I remember a patient who was under my treatment for a long time, and although he suffered continually from a pain in the larynx, upon examination with the laryngoscope not the least trace of a change in the position of the cords was found, and in the end he died suddenly of a saccular aneurysm of the aorta. This is a case that could uphold the old theory of Long and Lushka, that the recurrent nerve contains sensitive fibres, also, coming perhaps from the superior laryngeal through the medium of the anastomosing filament called "the bundle of Galen."

According to Kandoresky, the sensitive anastomotic fibres are divided into two bundles, one of which remains under the control of the inferior laryngeal, while the other—the more bulky bundle—leaves the trunk of the recurrent nerve and is distributed to the tracheal mucosa.

In conclusion, to my mind the pain which patients sometimes complain of in the first stages of compression of the recurrent nerve is occasioned by an irritated condition of the sensitive peripheral fibres of the larynx, above all of the healthy part, which is called upon to perform a greater functional labor in order to compensate for the reduced activity of the other part, which is hindered by increasing neuritis of the recurrent nerve.

But the gravest symptom, and at the same time the most difficult to explain, is the cough, without any phenomenon of altered mobility, which very often is the beginning of phonetic and respiratory disturbances in persons affected with aortic atheroma, or with dilatation and aneurysm of the arch, and which, in some cases, is the only disturbance that admits of relief.

How can this be explained? How can the origin of the different impulses of this reflex act be determined? Physiology treats it in a very few words, saying that cough is an act caused by the exciting of the peripheral ramifications of the superior laryngeal nerve in the laryngeal mucosa or of its central stump after resection. But here again, it must be remembered that, for the most part, in phonetic respiratory disturbances caused by compression of the recurrent nerve, the sensitiveness of the laryngeal mucosa is greatly diminished, so much so that a probe can be introduced into the larynx through the glottis without producing any reflex acts and without the need of any anesthetic.

Now, in cases of compression of the recurrent nerve, which most writers consider exclusively motor, the laryngeal cough region, innervated by the superior laryngeal nerve, atrophies according to the more or less pronounced compression which the aorta exerts upon the recurrent nerve; therefore we must seek some other explanation of this reflex act, which, as we have already stated, is now and then the only symptom of compression of the recurrent nerve.

If it were indeed true, as I personally think it is, that by the excitation of the central portion of the inferior laryngeal, a contraction of the expiratory muscles would be produced, it would be proved without the need of any further demonstration, first, that the recurrent nerve itself distributes a number of sensitive fibres to the mucosa of the trachea; secondly, that the cough can not only be dependent upon the irritative lesion of the superior layngeal, but also is in direct relation with the parenchymatous neuritis of the recurrent nerve.

Of course, in order to conclude that central excitation of the recurrent nerve acts upon the larynx, there are wanting further facts which must be determined by study of the small cells in a state of chromatolysis in the jugular and nodal (plexiform) ganglia of the pneumogastric, where all the sensitive fibres contained within the trunk of this nerve come together.

To strengthen the judgment just expressed as to the importance which must be attached to cough as a symptom of compression of the recurrent nerve, and as a sufficiently valid index to the mixed nature of this branch of the pneumogastric, I subjoin a few illustrative cases, of three of which I can furnish radiographic proofs.

Case I.—A. B., already passed his 57th year, states that in his tenth year he had a syphilitic infection which was regularly cured; he has always enjoyed good health, but during the last six months has been suffering from shortness of breath in walking upstairs, and has been troubled with a cough which comes on continually in starts or jerks and which becomes excessive upon moving the neck quickly, especially when lying down. The patient refers this cough to the throat; the slight expectoration coughed up is streaked with blood owing to the great effort made. An examination of the thorax reveals a distinct dullness in the region of the aortic arch, while the image upon the laryngoscope shows a simple diffused hyperemia of the cords. The patient never had any phonetic disturbances and died after two months from the rupture of an aneurysm.

Case II.—P. C., 37 years of age and a heavy drinker, about nine months ago began to suffer from a cough brought on by a tickling sensation in the throat, to which was added a slight hoarseness after two months. An examination with the laryngoscope showed the left vocal cord immovable and in an intermediate position between the phonetic and respiratory state.

Case III.—A. N., 49 years of age, has never had any ailment to amount to anything. However, fifteen years ago he contracted syphilis but was regularly cured. For the past three months, he suffers from a dry, irritating cough, which is especially pronounced after the least effort. An examination with the laryngoscope shows the glottis in a normal condition, except a slight hyperemia of the cords, due in all probability to the fits of coughing which for the past fifteen days have become more frequent and more troublesome; there is no trace of motor lesions of the left half of the larynx, while the radiograph, here shown, reveals an ectasia of the aortic arch (Fig. 1).

Case IV.—O. F., 59 years of age, has always enjoyed good health; though somewhat slender from girlhood, the last two years she has inclined to obesity. She has given birth to numerous children and absolutely excludes the suspicion of syphilis.

For about two years she has been tormented with an insistent, irritating cough, which lately has come on in such paroxysms as to render repose during the night impossible; morphin, codein, etc., taken in large doses, can scarcely stop the paroxysms and then for a short time only.

Lately, the characteristic symptoms of gout have manifested themselves in her hands and feet. A radiograph revealed a pronounced lesion of the aortic arch. The image on the laryngoscope was in nowise able to aid in determining the cause of the cough, since in the position of the vocal cords there were not the disturbances which constantly accompany a lesion of the recurrent nerve.

The radiograph here shown (Fig. 2) reveals to a certainty a most pronounced lesion of the arch of the aorta.

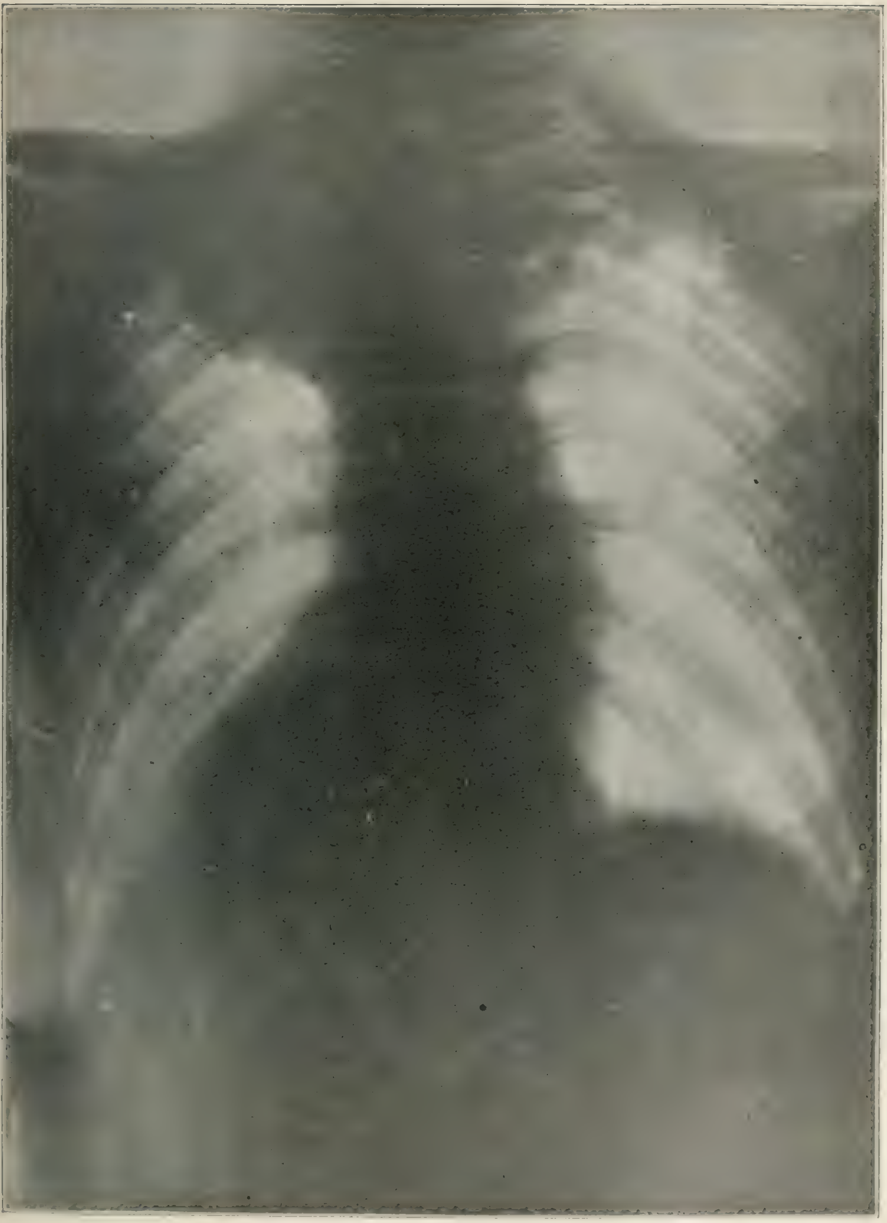

Fig. 1.

Fig. 2.

LXIX.

A CONTRIBUTION TO THE DIFFERENTIAL DIAGNOSIS OF CERTAIN MALIGNANT DISEASES OF THE LYMPHOID TISSUE OF THE THROAT.

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In the following paper, I wish to bring to your attention a group of affections of a malignant character, with localization in the pharynx and nasopharynx. These conditions are recognized in literature as pseudoleukemia, lymphosarcoma, malignant lymphoma and sarcoma.

Much confusion exists in literature with regard to the divisions between these conditions. Mamlok in 1899 reported a case to which he gave the name of malignant lymphoma, and discussed the differential diagnosis between this condition and sarcoma. By malignant lymphoma of the tonsil is denoted a condition characterized by proliferation of the lymphatic elements of the organ, passing secondarily to the neighboring lymph nodes, not extending below the territory of these structures, and characterized histologically by an atypical increase in the numbers of lymphoid cells, and of the connective tissue framework. By sarcoma of the lymph glands is denoted a condition characterized by infiltration in the tissues of round cells or spindle cells, showing a tendency to break through the capsule of the organs, and invade the neighboring structures.

Simmons, in 1903, distinguished between pseudoleukemia and lymphosarcoma or sarcoma. The former differs from the malignant growth in that only one kind of tissue is attacked, the lymphadenoid, and it does not infiltrate or tend to extend from one group of glands to those in continuity. In the metastases in the liver, lungs and other places, it can be explained as a disease attacking the small amount of lymphoid tissue normally present in these organs. He concluded that pseudoleukemia, or, as he prefers to say, Hodgkin's disease, should be regarded as an entity presenting a definite histologic picture. It has no relation to leukemia or tuberculosis, although the latter may be co-existent.

Sternberg, on the other hand, regards the disease as an atypical form of tuberculosis, and has reported a series of thirteen cases where Hodgkin's disease was established clinically, in eight of which lesions of tuberculosis were present at autopsy. While it is not infrequent to find tuberculosis in patients with pseudoleukemia, yet the weight of opinion now is in favor of regarding it as secondary infection, occurring in a debilitated individual.

In the following series of cases, it will be seen that the distinction between malignant lymphoma and pseudoleukemia is not possible to define. Sarcoma of the lymphadenoid tissue represents, on the other hand, a comparatively well-characterized morbid state.

Case I. A patient, 15 years of age, was seen May 13th, 1904, in consultation with Dr. Atkins of Holliston and Dr. Palmer of South Framingham, for enlargement of the right tonsil. The patient was large, well developed and unusually strong for his age. His throat had been perfectly well until four months before, when a short attack of tonsillitis occurred, followed by progressive enlargement of the right tonsil, together with swelling of the cervical nodes on the same side. There was no pain or discomfort. Examination showed the right tonsil to be the size of an English walnut, not adherent to the pillars, protruding to the median line, showing several crypts moderately dilated in its upper half, but no crypts over the anterior aspect of the lower half. The color of the organ was somewhat more bluish than normal. The cervical nodes on the right side below the angle of the jaw showed moderate enlargement, ranging from the size of a pea to a hickory nut, freely movable under the skin, and not tender on pressure. No glandular enlargement elsewhere was noted. The right tonsil was removed with the snare, and examined histologically. The tonsillar tissue was found to be replaced by a compact aggregation of small round cells, contained in the meshes of a fine network of connective tissue, lined with endothelial cells. The round cells had approximately the size and shape of mononuclear lymphocytes, and were disposed with regularity. There was no evidence of follicles. Examination of the blood showed no alteration in the size or shape of the cells. The white were essentially normal. The site of the operation healed in about two weeks. The patient was given Fowler's solution in increasing doses during the following three months. Examination August 30th, 1904, showed no lymphoid tissue apparent at the former site of the right tonsil. The cervical nodes had diminished slightly during this time. The patient felt and looked very well. On October 12th the nodes showed a continued diminution in size.

In February, 1905, the patient was taken by sore throat, characterized by pain and reddening of the pharynx, especially on the right side. The nodes simultaneously became larger. This inflammation diminished slowly during the following month, but the nodes in the neck began slowly to enlarge. His color and general condition were not so good, and the arsenic was not well-borne. This was consequently omitted, and the patient was given iron and quinin with other tonics. From this time until December, there was progressive loss of color and strength, and the nodes on the left side of the neck began slowly to enlarge. Examination of the blood at this time showed hemoglobin 70 per cent, whites 14,700, reds 3,840,000. Stained specimens showed increased variation in size of the red cells. White cells were not remarkable. In April, 1906, glands appeared in the axilla and groins, and a more rapid failure in strength was apparent.

Case II. A man, 42 years of age, seen Nov. 16, 1905, in consultation with Dr. Twitchell of Boston, gave the history of recurrent sore throat for many years, somewhat relieved by excision of a portion of the tonsils two years before. Since then, he had been well until two months ago, when the right tonsil became enlarged, together with the cervical nodes on the right side, progessively increasing. Examination showed the right tonsil and circumtonsillar region enormously swollen, passing beyond the middle line of the uvula. The free surface of the tonsil is relatively small, being two centimeters in transverse diameter, most of the tonsil being evidently covered by the anterior pillar. The tonsillar surface itself is markedly reddened with finely granular surface, denoting ulceration. A portion of the tonsil was excised, and showed on histologic examination numerous closely appressed round cells, having the character of lymphocytes, contained in a fine fibrous reticulum, lined with endothelial cells. There was no evidence of follicles in the specimens. Examination of the blood showed nothing noteworthy beyond a slight anemia. The right cervical nodes were enlarged to the size of two fists, causing marked distortion of the neck. The left cervical nodes were enlarged to the size of two pigeon's eggs, and the posterior cervical nodes to the size of peas. No enlargement of the lymph nodes was found below the clavicles. The spleen was not enlarged. The patient was put on increasing doses of Fowler's solution, with marked improvement for a time in every way. The tonsillar and lymphoid enlargements became progressively smaller. After three months, however, the nodes again became enlarged, and the right tonsil increased in size. Examination June 15th, 1906, of the blood showed no increase in the number or proportion of white cells, and no essential deviation from normal in the red cells. The swelling in the throat had by this time increased to such an extent as to interfere with respiration, the right tonsil passing far beyond the middle line, while the posterior pharyngeal wall exhibited a marked infiltration of a comparatively soft character, apparently due, so far as could be determined by palpation, to the enlargement of the pharyngeal follicles. The surface of the tonsil showed a friable, easily-bleeding, fungus mass. Suffocation was threatened and it was decided to remove, if possible, a portion of the obstructing right tonsil. Early in the etherization, however, respiration ceased, and tracheotomy was immediately performed, followed by artificial respiration. By the insertion of a tracheotomy tube, the patient breathed comfortably, and during the following two weeks gained considerably in color and strength. Death occurred early in July, from a sudden suspension of the heart's action.

Case III. A man, 62 years of age, was seen September 1906, for enlargement of the left tonsil. In January of this year, he first noticed pain on the left side of the throat, associated with progressive enlargement and difficulty in swallowing. There was no swelling externally until two weeks ago, when some lumps were felt under the angle of the left jaw. Examination showed the site of the left tonsil to be occupied by a mass about the size of a pigeon's egg, covered anteriorly by the reddened, smooth mucous membrane of the anterior pillar, and presenting behind the aspect directed toward the median line an ulcerated surface with a finely granular irregular floor, here and there covered with necrotic detritus, moderately firm on pressure and easily bleeding. The cervical glands under the left angle of the jaw ranged in size from that of a pea to a hickory nut. A portion of the tonsillar growth was removed for microscopic examination and examined histologically. The report of Dr. Simmons showed the specimen to consist of "a small piece of tissue 1 cm. in diameter from the tonsil. This was covered on one side by apparently somewhat thickened mucous membrane. The rest of the substance was composed of soft grayish white, somewhat friable tissue, in which were one or two small hemorrhagic areas. Microscopic examination showed the tissue very cellular and composed of masses of round cells closely packed and separated in a few places by fine bands of fibrous tissue. The cells had small, rounded but somewhat vesicular nuclei, and an extremely small amount of protoplasm. In places were irregular necrotic areas in which the nuclei had undergone fragmentation. This tissue was covered by normal stratified squamous epithelium. Diagnosis: Round cell sarcoma."

Case IV. A boy, 4 years of age, was seen March 2, 1900, for tonsils and adenoids. Examination showed the left tonsil to be exceedingly hypertrophied, passing beyond the uvula, and coming into contact with a moderately enlarged right tonsil. On palpation a large amount of adenoid tissue was felt in the nasopharynx, chiefly on the left side, a fact which was considered somewhat remarkable at the time, but did not lead to suspicion of anything beyond an ordinary lymphadenoid hypertrophy. The soft palate above the left tonsil was somewhat more prominent than the corresponding spot on the right. Under ether, both tonsils were removed, together with a large adenoid mass from the left side of the nasopharynx. A large retropharyngeal mass was felt on the left, below the surface of the mucous membrane, suggesting at the time a glandular enlargement. The child recovered from the operation uneventfully, and was able to breathe comfortably through the nose for several weeks, when examination showed an enlargement again in the nasopharynx at the site of the mass which had been removed. This was again excised, and found histologically to be a lymphosarcoma, the tissue consisting of masses of round cells, closely aggregated and obliterating the ordinary adenoid tissue. The child, who had previously appeared of good color and reasonably well-nourished, began at this time to lose distinctly in strength and flesh. Examination of the blood showed it to be essentially normal except for a moderate anemia. During the following two months the combined serum of streptococcus pyogenes and bacillus prodigiosus was administered, at first with apparently beneficial results. During May, the mass in the nasopharynx began again to enlarge, and interfere with respiration. On examination at this time the retropharyngeal wall was seen to protrude forward about one inch from its normal situation, particularly on the left side, with the result of interfering materially with deglutition and respiration. Tracheotomy was done and the condition of the patient relieved so far as comfort was concerned, but a progressive loss of strength continued, and death occurred early in June. During this time examination failed to disclose enlargement of the glands in other situations.

Summary of Cases: In Case I we see progressive enlargement of one tonsil, without ulceration, associated with swelling of the adjacent lymph nodes, followed by a general involvement of lymphadenoid tissues in other situations, giving finally a characteristic picture of Hodgkin's disease.

Case II is characterized by an initial enlargement with early ulceration of one tonsil and involvement of the adjacent lymph nodes, running a comparatively rapid course, terminating in a genuine Hodgkin's disease.

Histologically, these cases were characterized by proliferation of the endothelial cells of the reticulum, and of the center of the follicles, in association with numerous lymphoid cells, disposed without characteristic arrangement. In contrast with these, Cases III and IV exhibit alteration of the tonsils and adenoid respectively, and of the adjacent lymph nodes, without involvement of the lymphadenoid tissue in other situations. Histologically, these cases differed from Numbers I and II in the character of the cells, these being chiefly small round cells, with a comparatively small amount of intervening reticulum.

Case I would be classed at the outset as malignant lymphoma, and this would also be true of Case II, except for the early appearance of ulceration, which is commonly considered absent in this affection. It does not seem probable that the ulceration here can be regarded as a pressure necrosis, since it appeared before the disease had attained sufficient size to press upon the neighboring parts. It is possible, on the other hand, that the extremely rapid growth caused a thinning of the superficial epithelium with the result that abrasions were easily excited by the ingestion of food. Whatever the cause, it is sufficient to note the fact of the early loss of substance on the surface of the growth.

A consideration of these cases shows that Hodgkin's disease may begin in the lymphadenoid tissue of the throat, remaining there limited for a considerable time, before the development of manifestations in other organs. While such early local lesions may be considered identical with those occurring in cases described as malignant lymphoma, yet it would be more exact, and confusion better avoided, if such conditions were designated simply as Hodgkin's disease or pseudoleukemia originating in the tonsil. The term malignant lymphoma would, therefore, be best entirely dropped from literature. As stated by Simmons, and as confirmed by these observations, these early manifestations of pseudoleukemia differ from sarcoma in that the process proceeds by extension from one group of nodes to those in contiguity, and that only one kind of tissue is attacked, namely lymphadenoid. The metastases in the liver, lungs and other places can be explained as the disease attacking the small amount of lymphoid tissue normally present in these organs.

The term lymphosarcoma has been applied to conditions identical with those described in Cases I and II, but clearly on improper grounds, since these enlargements are not malignant in the sense of attacking other organs in the vicinity, nor are they composed exclusively of lymphocytes.

It is but fair to say, however, that some competent observers do not consider that a sharp line of demarkation exists between the group of new growths known as malignant lymphoma and pseudoleukemia, on the one hand, and lymphosarcoma or sarcoma on the other hand. While it may be shown eventually that insensible gradations may exist from one to the other, yet at the present, for the purpose of convenience, we may formulate the following points of distinction:

By the term pseudoleukemia (Hodgkin's disease, malignant lymphoma) is denoted a condition characterized clinically by progressive enlargement of the various organs of the body in which lymphadenoid tissue occurs, extending by the way of the lymph channels from one group of glands or nodes to those in contiguity, and exhibiting histologically a proliferation of the reticulum and marked increase of fibrous tissue, associated with numerous lymphocytes. By sarcoma of lymphadenoid tissue (synonym, lymphosarcoma) is denoted a malignant enlargement of such tissue, exhibiting clinically a tendency to invade the organs in the immediate vicinity, and characterized histologically by a replacement of the normal follicular structure by numerous round cells with a small amount of endothelial reticulum.

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LXX.

MALIGNANT DISEASE OF THE TONGUE, WITH A REPORT OF TWO CASES.*

By Joseph H. Bryan, M. D.,

WASHINGTON.

It is apparent to everyone that malignant affections of the tongue and upper air passages are on the increase, and I believe that it is only by the careful study of these affections both from the clinical side as well as from the pathologic standpoint, we can ever hope to gain any definite knowledge regarding this at present much unknown subject. In the majority of instances, it is the throat surgeon to whom these unfortunate patients first appeal for relief, and upon him devolves the responsibility of making an early diagnosis and of insisting upon an early operation in order to bring these cases to a successful issue. It is, therefore, very desirable that whenever the opportunity offers there be a free interchange of our experiences, and with that end in view I have to report two interesting cases that have recently come under my observation.

Case I. Last summer, while in Paris, I was consulted by a friend of mine, a man about 60 years of age, for what he considered an obstinate ulcer of the tongue. I knew him to be a man of abstemious habits, both as regards smoking and drinking.

On examination I found an indurated ulcer about the size of a ten-cent piece on the right border of the tongue, about its posterior third. It had an irritated appearance, caused by the use of strong applications of nitrate of silver and an iodin gargle, which he had been using on the advice of the several physicians he had previously consulted. There was a general sense of discomfort and occasionally pain at the seat of the ulcer. No enlargement of the glands on either side of the neck was observed. All local applications were positively prohibited, and he was referred to Mr. Butlin, whom he saw within ten days, who confirmed my diagnosis of a malignant growth of the tongue, and urged an immediate operation. This was about the latter part of August. I reached London in time to be present at the operation, which was done September 1st. A preliminary laryngotomy having been done, the whole right half of the tongue and a portion of the floor of the mouth was excised by means of the scissors, a gauze wick was placed in the back of the tongue near the floor, while the edges of the anterior half were brought together with cat-gut sutures. The patient made a rapid convalescence, being able to be about his room within ten days.

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*Read at 28th annual meeting of the American Laryngological Association, held at Niagara Falls, May 31, 1906.

About three weeks from the date of the original operation, Mr. Butlin made a complete dissection of the right side of the neck, removing all the glands that could be found. From this operation the convalescence was also quick and favorable, and he was able to return to this country about the latter part of October.

The pathologic report from the Imperial Cancer Research Committee states that nothing looking like cancer was apparent either to the naked eye or to the microscope in the glands; but that in regard to the tumor removed from the tongue, was extremely unsatisfactory; it states the growth is a well developed squamous cell carcinoma which infiltrates very widely, isolated groups of epithelial cells being found in the deepest parts of the thin slice from the center of the growth.

From the time of his arrival in this country until January 1st, he was under the careful observation of Dr. Collins Warren of Boston, after which date he returned to Washington and came under my care. I made three examinations, a month apart, and found him in a most satisfactory condition. There was not the slightest evidence of any return of cancer in the mouth, and while not expecting any trouble on the left side of the neck, I carefully searched for enlarged glands on that side as well as on the affected side. March 13th, two weeks after the last examination, he reported at my office, stating he had discovered a small swelling in the left side of the neck. The examination revealed a small glandular enlargement about the size of an almond, located about the bifurcation of the common carotid. There was no tenderness and no other enlarged glands could be detected. He then stated he had an imperative business appointment in Florida, which he desired to keep. I at first advised against his going, but finally yileded, with the understanding that he should return immediately if he found there was an increase in the swelling. Instead of being absent two weeks, as he expected, he returned within five days. The glands in the neck had enlarged very rapidly, a large painful mass could easily be felt over the carotid artery, the tongue was heavily coated and he had intense pains extending over the left side of the face and head and down into the left arm.

Dr. Finney was called in to see him, and it was decided to operate, which he did March 28th. As soon as the neck was opened his condition was found to be much more grave than we anticipated, a large cancerous mass was found in the deeper parts of the neck well under the steno-cleido mastoid muscle, and so firmly attached to the internal jugular and the common carotid that the coats of these vessels contained cancerous tissue which it was impossible to remove. It therefore became necessary to ligate and excise an inch or more of both vessels. The submental and maxillary glands were slightly enlarged, and they were also removed. The wound was then closed, except for the lower third of its extent, in which was placed a gauze wick for drainage. On opening the excised portion of the carotid artery, the vessel was found to be in the most advanced stage of atheromatous degeneration, and attached to one of the atheromatous plates was a large and firm thrombus. The duration of the operation was about two hours and the anesthesia used was ether.

The patient rallied well from the anesthetic and passed a fairly comfortable night, but about 8 o'clock the following morning he developed a complete hemiplegia. At 3 o'clock the same afternoon pneumonia in the left lung set in, and he died at 4 o'clock on the following afternoon, just forty-eight hours after the operation.

Case II. This case was in a man 70 years of age, unusually vigorous for a man of his age. I had been seeing him frequently for the past year or more for an obstinate dysphagia, without being able to find a cause for it. I saw him for the last time about the latter part of April, 1905, prior to his leaving town for the summer. Nothing abnormal about his larynx or fauces could be detected then. October 1st he came to see me for the customary examination, and I found at the base of the tongue a large mass projecting out of the larynx up to the level of the tongue, and having the appearance of an exaggerated degree of edema of the epiglottis. There was no pain in the region of the larynx nor any difficulty in swallowing. In fact, the patient was not conscious of anything wrong with his throat. The growth bled easily on manipulation. Examination of the neck showed a small glandular enlargement about the bifurcation of the common carotid artery on the left side; a small portion of the growth was excised and sent to Dr. Carroll, the pathologist of the Army Medical Museum, for examination. The following is his report:

"An examination shows that the condition is one of surface epithelioma without the formulation of pearls. The dipping downward of the growth from the surface epithelium can be clearly traced. The location appears to be at the junction of the tongue and epiglottis, and the transition from stratified squamous epithelium to minute papillae is distinctly shown. No muscle fibres are found, and the underlying tissue consists of lymph nodes and alveolar tissue rich in lymphoid cells and lymph vessels."

An operation was decided imperative, and Dr. Finney was asked to take charge of the surgical side of the case. October 17th, the patient being under anesthesia, Dr. Finney did the Kocher operation. As soon as the tongue was drawn through the opening in the mylohyoid muscle, the floor of the mouth and the upper part of the larynx were brought well into view. It was then discovered that the growth sprang from the base of the tongue, and the epiglottis was not at all involved, as we were led to believe by the laryngoscopic appearances. The epiglottis was, however, curled upon itself from the pressure of the growth. The left half of the tongue was removed and a portion of the base of the right half. The submaxillary and sublingual and several enlarged cervical glands were also removed through an incision carried some distance down to the neck. The wound was then partially closed and a gauze wick passed from the mouth through the opening in the most depending portion of the wound in the neck.

The patient made a slow but uninterrupted recovery, the wound taking about six weeks before it completely closed. He was very much annoyed during this period by fluids and food passing from the mouth through the wound, necessitating frequent changes of the dressings. The sinus finally closed, but there was left a thick and indurated condition of the neck over the site of the sinus.

The articulation in this case was very much disturbed in the beginning, but of late has been gradually improving. Another annoying symptom, and one that continues to trouble him very much, is the constant accumulation of mucus in the mouth.

In the early part of April the swelling in the neck became very red and painful and finally broke down, discharging some pus. At first it seemed as though this was a secondary infection of the skin, but under the use of the X-rays the parts thoroughly healed again, and all the thickening and induration have been absorbed, and at present, nearly eight months since the operation, there is no indication of any recurrence.

These two cases are both interesting and instructive, and show the decided importance of an early recognition of this dreaded disease. Jacobson and Steward in their work on "The Operations of Surgery," state that it will be a happy day when the belief is accepted and acted on, that cancer of the tongue, like many other epitheliomata, has a precancerous stage, and this is the stage when we should operate. The terrible malignancy of cancer of the tongue is shown by its rapid development which is aided by the warmth and moisture of the mouth, and by the constant irritation it is subjected to, and also by the almost certain and early invasion of the glands of the neck.

Case I is an unfortunate example in the delay of recognizing the disease, and shows several features, especially the absence of infection of the glands of the neck on the affected side, and the sudden outburst in the glands on the opposite side of the neck. Mr. Butlin, in speaking of the case, says it evidently was hopeless from the beginning, but we should not take a desponding view of the treatment of epithelioma of the tongue; it was an exceptional case and an earlier operation might have had a more successful result. He also states that affection of the glands on the opposite side of the neck, when the disease is actually on the border of the tongue, as it was in this case, is a very unusual occurrence, although he has met with it two or three times. He is not prepared at present to advocate the removal of the glands on both sides of the neck in every case of cancer of the tongue; but, on the other hand, he does not venture to declare that it may not become a routine treatment at some future date, when we have more information regarding the proportion of cases in which glandular affection of the opposite side is likely to occur.

Case II was also of a highly malignant type and showed an unusually rapid development. Of course, it is too soon to say what the final outcome of this case will be.

LXXI.

TREATMENT AFTER THE RADICAL OPERATION FOR CHRONIC SUPPURATIVE FRONTAL ANTRITIS.*

BY DR. H. LUC,

PARIS.

Innumerable methods of operation for the radical cure of chronic suppuration in the accessory cavities of the nasal fossae, especially the maxillary and frontal sinuses, have had their day in recent years. It is only fair to note that a goodly number of these pretended new methods were characterized by insignificant modifications of former methods. One single thought seems to have inspired the majority of their authors, that of establishing as large a communication as possible between the nasal cavity and the suppurating focus, after freely opening and carefully disinfecting the latter.

It is generally agreed nowadays that so far as the frontal sinus is concerned, this central idea has been ideally realized by the method of Killian, by resection of the ascending branch of the maxilla and creating directly in front of the ethmoidal labyrinth a large opening which permits deep destruction of the latter, and enlargement of the fronto-nasal communication which is generally insufficient, under normal conditions, for good post-operative drainage of a frontal sinus, no matter how small.

Killian has given a clear description of his method, which has been reproduced in most of the rhinologic journals, and which it has been possible for the majority of us to practice successfully upon the living after trial upon the cadaver. On the other hand, I believe I speak for a number of my colleagues in noting the hiatus relative to the post-operative care demanded by the operation. In this respect, those of my colleagues who, like myself, have done Killian's operation according to description, have been driven to groping, correcting from one operation to another the imperfections of their technic. I believe, then, that I am doing useful work in setting forth the rules of procedure which I have acquired from a personal experience of twenty cases.

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*Translated by Albert Miller, A. B., M. D., St. Louis.

I will suppose that the operation done has been that of Killian (which I consider really the best and most likely to avoid post-operative accidents). I will suppose furthermore, that the operative breach has been proportionate in its extent to that of the frontal sinus, of such a sort that none of its ramifications have escaped curettage and disinfection, and that by complete resection of the ethmoid cells a communication as large as possible has been established between the frontal focus and the nasal fossa. Also, that not only has the resection of the anterior wall been carried to the extreme superior and external limits of the bony cavity, but that care has been taken to avoid the subsequent existence of any angle of bone which may produce ulceration by pressure upon the skin carefully applied to the deep osseous cavity.

With these precautions the patient has every chance of a prompt cure, that is to say, in three or four weeks, if his frontal sinus does not conceal any prolongation which has escaped opening and cleaning, and if no ulterior fault has been committed.

Before entering upon the question of post-operative care, other matters present themselves: Is it wise to tampon and keep the sinus tamponed for one or several days with absorbent gauze, either iodoformized or not? May we or should we immediately and completely suture the cutaneous wound? As for the first question, I admit having adopted up to the last two years the practice of tamponing the sinus with iodoform gauze, introduced, before suture of the wound, into all the ramifications of the sinus, while the other end was carried through the large nasal communication to the nasal entrance. Since then, being desirous of simplifying an operation so long and complex in its other steps, I have stopped this technical detail without regret, preferring at the end of the operation to apply the skin deeply to the bony walls above the orbital arch which has been conserved. It appears to me that real benefit to the patient has resulted from this simplification, and he is thus spared the pain of extracting the drain and the inconvenience of its presence in the nasal fossa.

More delicate to trench upon is the question of immediately uniting the cutaneous wound. For my part, I have always done it, except in one patient in whom the very extraordinary dimensions of the frontal antrum had favored a recurrence from retention, an accident which I had tried to avoid at my second operation by keeping the external wound open for several days by a large drain. After the visit which I made that same year to Professor Killian's clinic, and after a conversation with him concerning a case of frontal antritis complicated with infection of the soft parts which he operated upon in my presence, I was rather disposed to imitate his example in similar cases, that is to say, not to suture until after twenty-four or forty-eight hours, during which the cavity was kept packed with gauze. I imagine that in such cases a moist dressing would be better for disinfection. Killian thinks that this precaution is the best means of avoiding post-operative erysipelas. In fact, I recall two cases of erysipelas terminating fatally which were naturally explained by the fact that immediate suture had been done upon the infected skin as was shown by edema and redness. Aside from this, it appears to me very advantageous for the patient that, the moment disinfection is complete and free communication with the nasal fossa is created, the wound should be immediately united.

Suture having been done, the indications for treatment are limited to three, as follows: (1) To take the rectal temperature for three weeks, morning and evening, in order to avert right at the beginning the slightest symptom of retention. (2) To preserve perfect communication between the sinus and the nasal fossa. (3) To promote the attachment of the skin to the deep bony walls.

In the great majority of cases when Killian's operation has been done according to the author's rules, there results such an enlargement of the fronto-nasal duct that we need hardly fear retention, which we see too often at the third week after the so-called Ogston-Luc method. Nevertheless, it is indisputable that the passage in question, however large it may appear after the operation, shows after a few days a marked tendency to contract. This circumstance, together with the peculiar character of the pathologic post-operative secretions in the nasal fossa, generally thick and tending to form crusts, explains how the latter may at any time block up the focus and be an obstacle to the escape of pus. So I have adopted the practice, no matter how few the crusts may be, of extracting them from the nasal fossa each day by means of a special long forceps. Then with a cotton carrier with a curved end, the concavity being directed above and forward, and the swab impregnated with hydrogen dioxid, or an iodized solution, I sweep it without violence through the fronto-nasal tract which is generally easy to distinguish. In this manner its permeability is absolutely assured. On the other hand, I disapprove of every sort of lavage which might result in infecting the newly sutured skin wound. I advise the patient, also, not to blow his nose except with moderate effort, in order to avoid distension and infiltration with air of the soft parts which are not yet firmly united over the breach. Finally, it has seemed to me useful, as soon as the crusts begin to form in the nasal fossa, to have the patient use a mentholated spray several times daily to soften the pathologic accumulations and aid their expulsion.

However small the frontal antrum may be, requiring a corresponding resection of its anterior wall, it is usual, if the operation is successful, for a slight depression to appear over the wound between the second and fourth week. This depression becomes more accentuated subsequently as the pathologic secretions diminish and the scar tissue develops which tends to unite the skin with the depths of the bony cavity. My experience has taught me to consider this depression as an excellent sign of cure. Although its formation is often the spontaneous result of cicatrization, as I have just said, I believe it is advantageous to favor its appearance, to fish for it so to speak, by exerting slight compression beginning with the first dressing, over the opening, by means of gauze pledgets piled upon each other and corresponding as nearly as possible to the size of the breach. Care should be taken in applying the elastic bandage to make the turns from above downward so as to force the contents into the nasal fossa and not shut them up inside. Besides, the pressure of the bandage should be very moderate, especially if the bone borders have not been carefully smoothed. In fact, I have had occasion to observe several times in these conditions the appearance of phlyctenules followed by ulceration of the skin and evidently due to compression against the borders mentioned, perhaps also favored by section of the cutaneous filaments of the frontal nerve thus predisposing the area to trophic troubles. I have adopted the practice of keeping on the compressive bandage for a month after operation, both to protect the region from trauma and to avoid the risk of distension of the sinus with air from intemperate efforts to blow the nose. I am also careful to renew it often, in order to watch the progress of skin attachment and to avoid the above mentioned inconveniences of exaggerated pressure.

In the great majority of cases, when the operation has been well done, that is to say, when it has fulfilled the double indication of completely disinfecting the fronto-ethmoidal focus and creating a free fronto-nasal channel, and the subsequent maintenance of this channel, complete cure is attained in about one month. Thereafter, the frontal bandage becomes useless, and the patient requires less and less care.

LXXII.

HOW FAR ARE ABNORMALITIES OF THE NASAL SEPTUM RESPONSIBLE FOR MAL-FUNCTION OF THE NOSE?

By Henry L. Swain, M. D.,

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NEW HAVEN.

It is well-nigh axiomatic, an aphorism, that if a person received the divine heritage of an anatomically and physiologically perfect nose and always lived a perfectly ordered life ever after, he, or more presumably she, would never suffer from catarrh, using the word as a generic term for nasal disease. With a perfect and perfectly functioning nose very little or no throat disease would exist, unless of tonsillar (lymphoid) origin or arising from systemic conditions. Assuming that germs existed coeval with man's origin, if not before, man is a mere incident to their career. They are parasites; man, the host or domicile. In ages past certain races of men may have been worn out for the use of some kinds of germs, so these last underwent certain changes which enabled them to still do business with the genus *Homo sapiens*. Of these acquired characteristics, some remained and, by the aid of these, various races of germs have been perpetuated, so that we now have big and little, ærobic and anærobic, capsulated and plain, crooked and straight, intercellular and free, cocci and bacilli. The cells of man have no sooner learned to repel one of the kinds than a new horde with different habits and desires swoop down upon them, and new protections must be erected, new defences established.

Inasmuch as it would be obviously a poor plan for either man or animal to always rely upon the ability of the cells to cope with the germs and thus repel disease, gross methods of protection have always existed and are first used, and it is only on the failure of these that work is demanded of the cells themselves. Sneezing is perhaps the first method which is in use among animals to protect them against foreign matter which has entered the nostril, and from their sensitive mucous membranes the slightest irritant is immediately expedited, and sneeze follows sneeze until removal is accomplished. When exercising or otherwise more liable to get floating matter into the nose, the dog, for example, breathes through the mouth, so that nothing may interfere with the important function of scent. In man and most animals, the sneeze is followed by a flow of fluid, usually free from mucus, which in man represents not always a secretion from the glands in the nose, but rather a transudation through the cell interspaces in addition to the flow from the lachrymal glands. Man helps the cleansing or removal by voluntary act of blowing the nose or snuffing back into the throat, followed by hawking. By these gross means, gross or macroscopic irritations when present are removed. Smaller or microscopic particles which are floating in the air are first held up by the small hairs which grow more or less profusely at the entance of the nose. These, especially when moist, must act as an effective sieve. Whether there is anything providential in the fact that the older one grows the more abundant these hairs appear to be, is a matter for conjecture. Beyond the openings the mechanism of the perfect nose is admirable; divided by a septum in two equal parts, each with its subdivisions of the space into convoluted tubes or fossae, bringing a large surface upon which to deposit the floating particles as well as a greater radiating equivalent in carrying out the physiologic functions of warming and moistening the air. This subdivision into two equal sides and these again into tubes or gutters is essential also for good cleansing by blowing, as we often learn to our sorrow in atrophic and diseased or deformed conditions. The general trend of the passages is downwards as well as backwards when the head is erect, hence exuded fluid, as from irritation, tends of itself to wash the foreign matter down and out of the nose—to the front largely by blowing, to the rear by gravity. All this is aided by the ciliated epithelium in certain parts, the ciliae working in a general way backwards and downwards, helping very much, in my judgment, in preventing that prolonged sojourn of finely divided matter, whether active or not, which results deleteriously to the exposed parts. A further aid comes when by the swelling due to the erectile tissue the tubular passages become smaller, making the cleansing, when continuity is uninterrupted, from any given effort easy. The passage of a large quantity of air through a smaller tube gives greater frictional (cleansing) possibilities than when the same amount of air with equal velocity traverses a larger space. So it transpires that the gross anatomic arrangement serves well to stop within the nose floating bodies, and the parts most liable to thus bear the burden and heat of the day are the anterior end of the middle turbinate and the inferior to a lesser degree. These project from the side of the nose where the currents of air must swirl past them with many an eddy as they stand boldly forth to stem the tide.

Now, allow that on the wings of a mighty inspiration floating matter has been wafted through the nose. The particles in the middle of the stream surge along until the current turns downward toward the larynx. Those with the greatest centrifugal inertia are thrown directly upon the posterior pharyngeal wall. Covering this whole posterior surface, where there is little or no ciliated epithelium, there is a protective layer of mucous secretion which immediately enmeshes anything which lands upon it. Gravity and fresh secretion soon expedite such detained matter downwards and out. So all kinds of dust must run the gauntlet ere they get into the larynx and trachea, and, although much gets through safely without let or hindrance, still the protective apparatus does lessen the danger by the peculiar construction of the parts.

But how about the microscopic particles, the subtle germ whose entrance is not heralded by any such cataclysm as the violent sneeze? The entrance may take place in the dead of night, and only the ever watchful epithelial or endothelial cell by chemotactic sense or electric thrill learns that the invader is at hand.

When the sentinel gives the alarm immediately the leucocyte, with phagocytic appetite, sallies through the portals, and with his exit from vessel and tissue more of his kind are hurried to the front, more blood comes to the vessels, they passively stretch, capillary congestion and venous stasis allow the passage of the white cells and serum into the tissue, the whole membrane swells, mucous glands pour forth abundant mucus, contacts are established between adjacent areas, sneezing again results, either from mere contact or from fluids running down between surfaces not absolutely touching, and the fight is on.

This considers merely the nasal mucosa, not the tonsils. Here the process is so different that another figure must be used. That we do not oftener have nasal invasions comes from the mechanical action of the normal ciliated epithelium. The removal is aided by the fact that serous fluids constantly present on the surfaces have a deterrent effect on germ growth if not actual germicidal action. Life is not easy for the germ, and unless it is midway in the stream of air and strikes no hindrance on its way to the trachea, the convoluted surface of the nose catches it, usually to its death.

Whether as in adults, upon the broad arched roof, or as in children, on the shallower and more sloping vault, if the germ is caught upon the posterior pharyngeal wall, it meets lymphoid tissue, and here lies the most active of the repellent forces of the upper air passages. Immediately beneath the epithelial layer, which is of the flatter, squamous type, and even between the cells themselves, lie thousands of potential leucocytes capable of amebic motion, and although the lymphoid tissue really is but a modified lymph node, still within its outer walls of epithelium lie a vast army of rapacious phagocytes which rise in wrath and indignation to combat with the invading hosts. So here again the unlucky germs when, by their very speed, they are carried past the outworks of the nose find defenders present and usually perish.

Thus it is reasoned that the anatomic arrangement of the nose is such that, by the free flowing of mucus, the motion of the ciliated cells, and the general trend downwards and backwards of the passage allowing the protecting fluids more easily to accomplish their cleansing, it actually tends to remove all inorganic and insoluble matter and to thwart the prolonged resting of the living and active substances. The chemical or phagocytic destruction of living organisms falls upon the cells by the failure of removal by these previously mentioned means.

Several ways exist naturally to render the protective system useless. First, the grosser methods are rendered impossible by deformities of the skeleton of the nose, rendering ready cleansing by sneezing and blowing and the free downward flow of fluids practically impossible. Here is a chance of which the invaders readily avail themselves. Skulking back of a large exostosis, they evoke secretions which remain in situ, producing a splendid breeding ground for the germs, warm, snug and nutritious, and hundreds, yes thousands, are bred where one attacked at the beginning, and their very numbers overcome the cell defenders in that little area, resulting in an acute rhinitis. Mayhap an artificial cleanser might have removed the intruders, but natural methods failed because of unnatural conditions. The cells were all healthy perhaps, but the odds against them in a limited area were too great.

The protective organization depends again on the itegrity of the outer wall, the eplithelial layer. Suppose through injury some considerable area of ciliated epithelium is dead, or through great debility or perhaps through prolonged exposure to great cold, chemical irritation or dry heat, the actual activity of all the ciliated epithelium in the nose should be reduced to the minimum, or even inhibited for a time. Then how easily could the hardy germ work in past the outer wall "while yet they slept who should protect." Under such conditions, or those of profound systemic depression, the activity of not only the ciliated epithelium but also the appetites of the usually voracious phagocytes might be reduced so that again the germ might get in beyond the outworks. Such or other conditions of the system might produce a different serum, might modify the amount of fluid actually running into the nose, or might add more or altered mucus in which germs would actually thrive. These are but a few of the suggestions which rush to one's mind whereby the outworks and defences of the nasal tract may, so to speak, be rushed and stormed, and thus the disease become systemic because the germ has lived to perpetuate its kind owing to lack of or imperfect cell-guard.

We have considered macroscopic and microscopic forms of invasion and the means of protection against them. What shall we say at this juncture of the yet subtler irritations, chemical, electric, we know not what, which are only apparent to the hyperesthetic cells of the susceptible, when they react to the immeasurably small particles proceeding from hay or flowers, from the horse or from the cat, or from a special brand of feathers, or even the odor of perfume, as musk? How intangible is such an emanation; as easy to grasp as an atom, as easy to see as an ion, as easy to understand as the mysteries of Providence, unless, forsooth, you are cursed with the responsive cells, and then all is so different. How excruciating the irritation, how obvious the tears, how abject the victim, until he feels sure that he represents the torments of the evil one. These, by all other means imperceptible forces, make themselves as evident to the victim as to another would be a dose of red pepper in the nostrils, and it seems to me the conditions are absolutely parallel. What an explosion of all the repellent forces we have considered takes place in both instances—sneezing, blowing, floods of serum and tears, even of mucus; what redness is evoked, what stoppage in the nostrils, all to rid the membrane of the irritant. The protective system is again trying to do its allotted work, and yet how infinitesimal the particle, how attenuated the influence, how it must be reduced to the utmost refinement of chemotaxis in order correctly to estimate what it means. If the unsusceptible are, on the one hand, so irresponsive, and the susceptible so abjectly enthralled, must there not be great differences in the characteristics of the cells themselves? And if of these in the nose, may there not be also similar differences in many other cells of the body? Is it not analogous—but equally mysterious—to the differences which must exist in the cells of the gray matter of a Huxley or a Kelvin as compared with those of an imbecile or an idiot? Nor does this problem present one whit greater difficulties than to understand how the nerve endings in the dog's nose discover to him his master's footsteps among those of a multitude, or lead the unerring bloodhound straight to his victim. Ponder as we may on these wondrous powers, another problem confronts us of equal difficulty. Solve it, and you have the key to all physiologic phenomena—yes, the keys of life and death are in your hand. How do the ever watchful epithelial or phagocytic white cells know that disease germs are present—distinguishing as they apparently do between inert matter which they allow to pass, harmless living matter which they allow to remain, and pathogenic germs which they endeavor to destroy? By what alchemy is the whole system aroused as the grippe germ begins work in our bodies? By what charm does the meningococcus reduce the guard at the front, pass in, and, having massed his army within the gates, in a moment, the twinkling of an eye, the victim lapses into unconsciousness, perhaps never to awaken? And yet our daily walk and perpetuity depend upon the vigilance, discretion and discrimination of a few cells. How little then must it take to disturb the happy equilibrium of decay and restitution which we call health; how little to knock out our protective system. And yet this is only the beginning of the problem.

From repeated acute attacks of rhinitis come chronic catarrhs. The existence of chronic catarrhs makes us susceptible to renewed acute attacks, and so the endless chain of cause and effect and effect becoming cause brings about chronic inflammation within the nose. The mere hyperplasia of repeated attacks of acute rhinitis is succeeded by hypertrophy, leads on the one hand to atrophy and on the other to edematous conditions and polyps, and both lead in the end to bone changes. Then we have the gross effects seen in the operating room of the surgeon and in the deadhouse.

In all these cases something defeated the plan of nature and the nose has ceased to be a perfect and perfectly functioning organ; in fact, it has become, instead of a safeguard, a menace to the health. Instead of cleansing and freeing itself of germs, it harbors them. Instead of secreting a fluid detrimental to germs, it serves up a most nutritious pabulum for their use. Instead of breathing pure air in open protest to sedition, it closes a nostril, and, granting to certain applicants the seclusion of private apartments, an antrum or a frontal sinus cultivates as pure and virulent a culture of a select breed of coccus as ever graced a laboratory incubator. Surely something has happened to disturb the order of nature, and it has been the habit of the rhinologist, either by open assertion or tacitly because of his unvarying practice, to lay the burden of all of this pathological change and disturbance of function when of a chronic nature to the septum, the erring brother upon whose shoulders as upon a scapegoat is ignominiously loaded all the blame for all that has happened. And never has a defender arisen for the poor helpless victim. Condemned without a hearing, and if but to a decent death, how differently might we review the past! The utmost refinement of savage butchery pales into sordid insignificance when the detailed sufferings of the nasal septum are spread before us.

Notwithstanding, however, the most unprecedented activity on the part of the profession, during the last twenty-five years, there have lived and died at a ripe old age in every community a few unmutilated persons. These have passed to the great beyond from reasons incident to senility or from accident or from disease of other parts of the body, having never suffered from impairment of hearing other than presbyakousis or any other so-called catarrhal difficulty which caused them to become the legitimate prey of the specialist, and yet they have harbored from their earliest infancy more or less crooked septa which they inherited as a result of facial asymmetry, these irregularities exaggerated by the accidents of disease, neglect of teeth and trauma in youth, so that they have possessed through years as grossly misshapen septa as it has ever been our fortune to hack and hew into the semblance of orthodox uprightness. And when we think, on the other hand, how rarely there ever is a straight septum, should we not be made to wonder, if our premises are correct, why anyone ever escapes with two good ears and a healthy pharynx?

And while we are on the point, have we not all got the septum habit, the habit of doing something to the septum so much as a routine that we feel that we have almost been derelict in our duty by the patient who applies for treatment of his nasal catarrh if we have not vigorously attacked the dividing wall of his nose? What has been the method of reasoning? Are we correctly understood when we are accredited with believing that the deviations of the septum from the straight and perpendicular are of such immense importance? We as members of this association and in our work as clinicians and teachers in medical colleges have certainly given the impression that the origin of the pathologic conditions known as chronic catarrh is to be traced in man to the disturbance of the function of the nose which results when the septum bends to either one side or the other, causing narrowing, pressure and lack of proper aeration. It has been usually reasoned that an exostosis, for example, which projects from the septum far over toward the lateral wall, must interfere with the function of the nose in three or four ways. First, the air could not with proper freedom pass through the nose; the whole stream of air must be turned one way or the other or divided by it. Second, it interferes with cleansing the nose by blowing. Third, it presses upon the mucous membrane of the turbinates when these swell, as in the ordinary physiologic ebb and flow of the blood in the nostrils or when irritated or inflamed. This constant condition of greater or less pressure interferes with the proper circulation in the membrane. It interferes with the cleansing. It interferes with the work of the protective system. It affords a chance for the retention of discharge. This discharge when retained may become fetid and irritating, may destroy ciliated epithelium by drying or by the virulence of the germs which are in culture in the fluid secretion. The dictum goes forth: as it can bear nothing but ill fruit, "Cut it down, why cumbereth it the septum?" Certainly with this view our attitude seems, in the light of the present-day conception, perfectly rational, perfectly proper. In a marked instance of this description as in a marked instance where the septum is bent so as to actually interfere with breathing, there can be no argument against ridding the host of such abnormalities and the difficulties resulting therefrom. It remains therefore, if these premises are accepted as correct, to accomplish this by as mild measures, with as little destruction of normal epithelium, and with as good preservation of the normal anatomical construction of the parts as possible.

I certainly cannot make it seem right to remove turbinate tissue when it is an exostosis of the septum which is at fault. It may be easier, but it is not logical. Neither can I make it seem right to remove turbinal tissue when what is needed is to make a crooked septum straighter. Especially to-day, when submucous resection in conservative hands seems so successful, there is no good reason for halting in one's duty.

And yet, when we come to look back over twenty or twenty-five years of work, to follow up the cases wherein we have done all these things by what at the time seemed to be the best method, has the catarrh that we seemed at first to relieve always remained permanently benefited? When we have done our best sometimes to straighten a septem and remove a spur, have we not merely improved conditions and not completely relieved, and are we not compelled many times after our utmost endeavors to cure great deformities to leave the patient's septum in a condition in which he is no better off than another unoperated patient who comes with a most atrocious catarrh? Do we not fall into the habit of laying the whole catarrh to this slight bend, which is no worse than the best result we could obtain in the other case, and have we not operated many times on these lesser curves, following out the idea almost from force of habit? And then do we not, if we see these patients years afterwards, find that they again have the hypertrophies, again have the frequent colds, again have the catarrhal dropping? Perhaps the polyps have returned and mayhap the sinusitis. We have in each of these instances gone to the full extent of what was needed in reforming the septum, and yet, in spite of these radical measures, again the catarrh recurs.

This must mean, then, that it requires something more than the bent septum to produce catarrh, and the question naturally arises: Is it not in the life that we of the present day are compelled to lead? The dust, confined, narrow apartments, the dry heat, the late hours, the busy work, all contribute to a condition of nose and body which causes a catarrh to return which, while the patient was directly under our care, certainly improved. These latter thoughts have been forced upon me in the last few years as, looking back over a considerable period of active work, I have been forced to believe that the septum alone is not responsible for all that we have placed upon it.

Since beginning the series of papers which I have presented to the Association in the last few years, when the relation of the arch of the palate to the septum was studied, I have made it the invariable rule with every patient who came in to examine the septum and to find out the amount of catarrhal difficulty existing, questioning the patients who came to me about other matters, not conscious of any catarrh, inquiring as to the amount of catarrh present at the time the patient came as compared with the years and years during which he must have had a crooked septum. I find that it is certainly possible for crooked septa to exist in healthy individuals who lead well-ordered lives without ever producing noticeable catarrh. Secondly, that we can bring the septum into subjection, straighten it, plane it down, smooth it off, and still colds and frequently repeated annual catarrhs continue, while sinusitis is brought about in spite of it all. Unless the life of the patient is changed in some way or his constitutional conditions modified, hypertrophy will again return, and it seems to me that we have fallen far short of our duty by our patient if we simply correct the errors of the septum and cauterize the turbinates. Ought we not then, as we present various ideas to the public, to right the impression which has gone abroad, thanks to our own faulty presentation it may be, that a rhinologist when he is not opening a sinus is merely the carpenter of the septum?

Certainly, having in mind the protective apparatus alone, we should bestir ourselves, take into our confidence if necessary the family physician, investigate into the life the patient is leading, into the finer details of every-day occurrences, to search out a method that shall have the wider, broader possibilities of therapy in mind rather than to confine ourselves so strictly within the narrow quarters of the nose and limit our endeavors to such stunted conceptions.

LXXIII.

SKIAGRAPHY IN THE DIAGNOSIS OF FRONTAL SINUSITIS.

By W. A. Chisholm, M. D.,

NEW YORK.

At the meeting of the Eastern Section of the American Laryngological, Rhinological and Otological Society, February, 1905, Dr. C. G. Coakley read a paper on the above mentioned subject. Basing his observations on forty-four skiagraphs which he had taken up to that time, he arrived at certain conclusions. One of these (the third) was as follows (Annals of Otology, Rhinology and Laryngology, March, 1905):

"In all cases of unilateral disease of the frontal sinus, verified by operation, we have observed a cloudiness in part or all of the area occupied by the sinus, and an indistinctness in the outline of the cavity when compared with the opposite or healthy side."

In its account of a discussion on the same subject at the Annual Meeting of the Association in June, 1905, the October number of the *Laryngoscope,* page 810, reports a distinguished member as expressing the following views:

"In regard to skiagraphy he said it was a very beautiful and instructive method of demonstrating the size of the frontal sinuses and their relation to one another, but he doubted the statement made by one of the speakers that it showed diseased conditions of the sinuses. He did not believe that the X-rays demonstrated the diseased sinuses in any way, shape or manner."

By the introduction of some skiagraphic prints later on, I shall endeavor to show that this is an erroneous opinion, which, I believe, could be arrived at only by studying an insufficient number of plates, or those that were inferior. In unilateral disease of the sinus, good plates show in varying degree, the characteristic differences specified in the first quoted paper.

The reason why the normal and diseased sinuses should present different appearances in the plate had not been definitely determined. Increased thickening of the mucous membrane, fluid contained in the cavity, changes in the bone, were all advanced as possible causes. The following experiments and deductions are the result of Dr. Coakley's suggestions to me that I try to determine the cause.

As I knew little or nothing about X-ray work, I applied to Dr. E. W. Caldwell, Director of the X-ray Laboratory at the University and Bellevue Hospital Medical College, for assistance. He kindly complied and to his skill I attribute any success that may have attended our efforts.

Mucous membrane was the subject of our first investigation. We desired to ascertain whether the shadow cast by a moist membrane differed from that of a membrane which had been previously dried. Two portions were taken from intestine, one of which was kept moist, the other spread on a thin board and carefully dried by means of an alcohol lamp. They were then X-rayed, side by side. Of the resulting skiagraphs Figs. I, II, III and IV are presented.

One end of each portion of the membrane was spread out flat, represented by (A), while the other end of each was folded on itself twice, thus giving three thicknesses at that part (B). This was done to aid comparison if the shadows were to prove very faint. In the prints the moist portion of one thickness (A) shows in Figs. 1 and 3 a deep shadow, markedly accentuated in the part folded upon itself (B). The dry portion, on the other hand, is scarcely visible in Figs. 2 and 4, in the section where there was one thickness (A), and the picture is not much more distinct in the part where there were three thicknesses (B). One can deduce from this that it is the moisture in the membrane that deepens the shadow.

Our next experiment consisted in determining whether pus or other fluid in a cavity cast a shadow in the radiograph different from that cast by a cavity filled with air. For this purpose empty gelatine capsules were selected. No. 1 was left empty, No. 2 filled with pus, No. 3 filled with saline solution and No. 4 filled with blood. Some difficulty was experienced on account of the softening of the capsules on introducing the fluids. As a consequence, the capsules containing pus (No. 2) and blood (No. 4) were not completely filled and a strip of adhesive had to be employed to retain them in position. Two exposures were taken, the first lasting one second, Fig. 5, the other lasting two seconds, Fig. 6.

In the prints presented, Figs. 5 and 6, the capsules containing the pus, saline solution and blood, Numbers 2, 3 and 4 respectively, cast deep shadows of practically equal intensity, while the outline of the capsule filled with air (No. 1) is barely discernible. The wavy band along the lower half of the capsules represents the adhesive. The bubbles of air in the pus and blood (Nos. 2 and 4) show very distinctly. These air bubbles, obtained by accident, proved a very valuable aid to us, showing that cavities filled with air cast a much lighter shadow than those filled with fluid.

The next step was to fill an empty frontal sinus with pus or something equivalent to it, and observe the change effected in the plate. Saline solution was chosen as it could be more easily handled than pus. As the fluid could not be introduced through the fronto-nasal duct, an incision was made over the sinus, and the bone exposed. With a small trephine an opening was made into the sinus, the cavity was filled and the button of bone and soft tissues replaced. It was found, however, that although efforts were made to plug the fronto-nasal duct, the fluid leaked out before a satisfactory plate could be obtained. It was decided that it was a matter of some difficulty to get fluid to remain in the cavity. Some substance that could be introduced as fluid so as to fill all parts, then solidify so as not to escape was required. It was essential also that it should cast the same shadow as pus. Gelatine was suggested and it was determined to try it.

First it was necessary to find what it showed on being X-rayed. As the capsules in the other experiment did not answer the purpose perfectly, a new method of comparison was instituted. A piece of hard rubber, six inches long, one inch wide and one-half an inch thick was secured. Six holes, ⅝ of an inch in diameter, were bored through it. A thin strip of gutta-percha was laid on the bottom and fastened to it with bicycle cement; this would not interfere with the rays. There were thus six receptacles of the same size and shape. Into No. 1 two c.c.'s of gelatine which became firm directly was placed. Into No. 2, two c.c.'s of pus was dropped. Into No. 3, blood to the same amount was introduced. Into No. 4, saline solution and into No. 5, water was placed—the fluids in each case being dropped from a measured pipette. No. 6 was left full of air. An exposure of one-half second was made (Fig. 7) followed by another lasting one second (Fig. 8).

The prints show in both figures the gelatine (1), pus (2), blood (3), saline solution (4) and water (5) displaying well marked shadows which appear to be identical in intensity, while the sixth (air) is clear. Judging from the shadows cast on these plates by the various substances, gelatine was equivalent to pus in casting a shadow.

Another head was secured which had previously been kept dry, so that no fluid would get into the sinuses. A radiograph was taken in order to map out the frontals. An incision was then made through the soft tissues beginning at a point a little outside the external angular process, extending up to the hair line, then horizontally and down to a corresponding point on the other side. The periosteum was peeled down below the supra-orbital ridge. With the first plate as a guide, four holes ⅛ of an inch in diameter were drilled into the upper margins of the sinuses so that in filling no air-bubbles would remain. The cavities were found dry and membranes normal. The soft tissues were then replaced and a second plate taken (Fig. 9).

This showed the right sinus apparently completely divided into two nearly equal parts by a bony septum and the left partially divided. The outlines were well defined, and the sinuses appeared normal. The openings made by the drill were visible. Gelatine was dissolved in hot water and cooled until it became syrupy; a syringe holding a dram, with a needle ⅛ of an inch in diameter so as to exactly fill the drill hole, was filled with the thickening gelatine. It was then allowed to cool still further until some little effort was required to expel its contents. The left side was selected for the injection. It seemed very capacious, requiring four syringefuls to fill it. A good deal of pressure was exerted in order to completely fill the same. The soft tissues were again placed in position and a final plate taken. The exposure was the same as in the other cases—thirty seconds.

The print of this last skiagraph shows what looks to be the whole left, and inner half of the right sinus, clouded and fogged with the outline very indistinct—an appearance identical with that shown in a diseased sinus. What appears to be the outer half of the right sinus up to the bony septum displays the appearance it previously presented. The real condition was disclosed by subsequent examination. The true septum dividing the sinuses was not in the median line, but was the one which appeared to be near the middle of the right sinus and showed complete in the first plate. Thus was produced a very large left sinus and a correspondingly small right one. An incomplete bony septum was found in the median line being defective in the lower end. No regret was felt that this condition existed as it rendered the picture all the more interesting.

For the sake of comparison I present prints of several skiagraphs showing diseased frontal sinuses. For these I am indebted to Dr. Coakley, who has kindly loaned them to me for this purpose.

Fig. 11 shows the right sinus clear and distinct, the left cloudy and indistinct. The print in this case does not represent the difference as clearly as the plate does. Operation revealed a sinus full of secretion but the mucous membrane was not perceptibly thickened. The trouble was largely obstructive, as the bottom of the fronto-nasal duct was so constricted that a small sized probe could not find an outlet into the nasal cavity. Here we have a nearly normal mucous membrane and a cavity filled with fluid. This agrees with the gelatine experiment.

Fig. 12 is very similar to the one shown of the sinus filled with gelatine. Here in the same way the left sinus extends far beyond the median line, rendering the right correspondingly small. The large left sinus shows hazy and dim in outline. Operation revealed greatly thickened membrane and pus in the left.

In this case transillumination and other evidences pointed to double frontal sinusitis. As complete confidence had not at that time been established in skiagraphy, an exploratory operation was performed on the left side. A dilatation of the infundibulum was revealed but no sinus in the vertical portion of the frontal bone, although exploration was thorough.

In conclusion: While no print can show the diseased condition as plainly as the original negative, these that have been presented distinctly show the difference between the normal and diseased sinuses, and I believe the value of the skiagraph as an aid in diagnosis of these conditions can scarcely be overestimated.

As a result of our experiments I think it may fairly be concluded that the characteristic appearance of a diseased sinus is due to the fluid contained, whether it be free in the sinus or contained in the thickened, edematous membrane.

The necessity of good skiagraphs cannot be insisted upon too strongly. A poor skiagraph may be sufficient to determine the presence or absence of a sinus and possibly the number and situation of the septa without being of any assistance in determining the presence or absence of disease.

As in other methods of diagnosis, the skilled observer notices changes which would escape the observation of a less practiced eye.

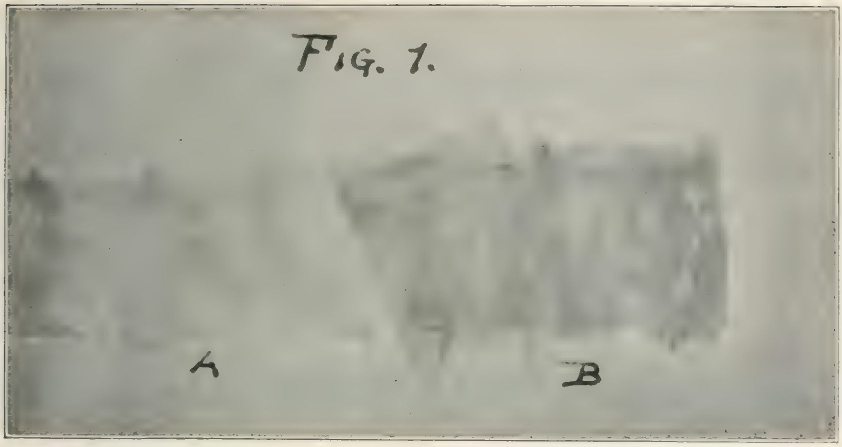


Fig. 1.—Skiagraph of moist intestinal mucous membrane. A—One thickness. B—Three thicknesses. Time of exposure, one second.

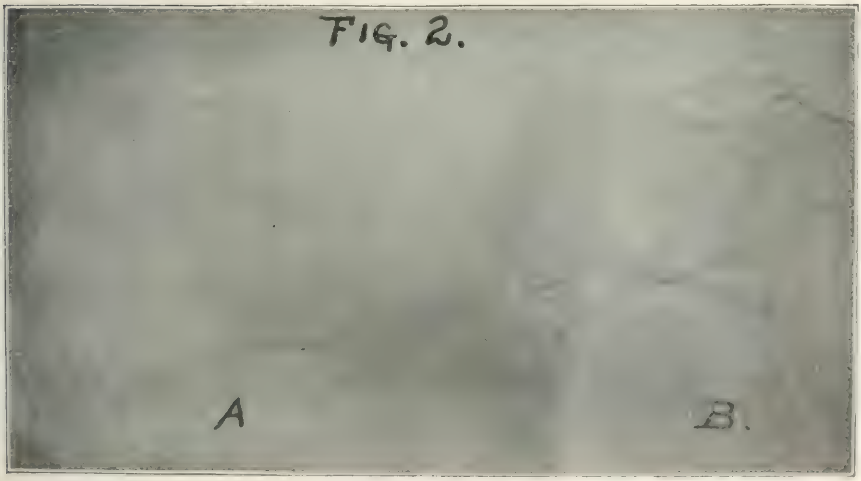


Fig. 2.—Skiagraph of dried intestinal mucous membrane. A—One thicknesss. B—Three thicknesses. Time of exposure, one second.

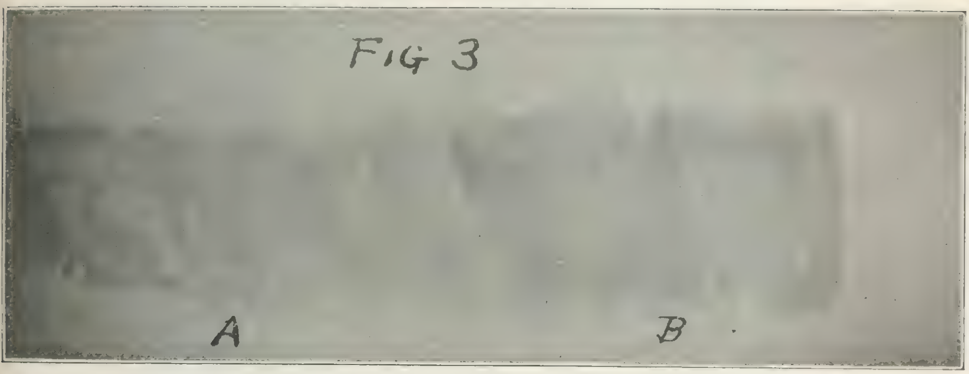


Fig. 3.—Skiagraph of moist intestinal mucous membrane. A—One thickness. B—Three thicknesses. Time of exposure two seconds.

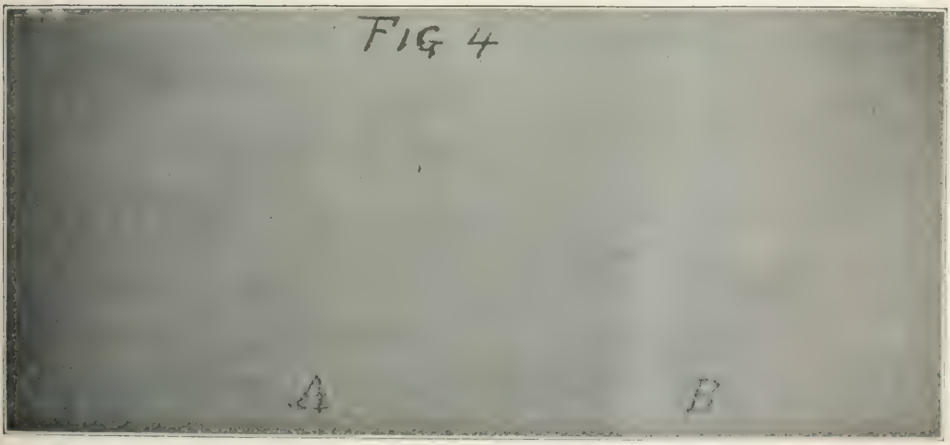


Fig. 4.—Skiagraph of dried intestinal mucous membrane. A—One thickness. B—Three thicknesses. Time of exposure two seconds.

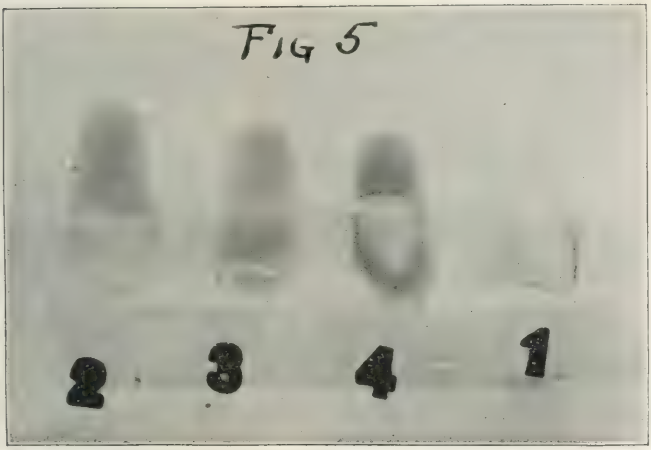


Fig. 5—Skiagraph of gelatine capsules containing (1) air, (2) pus, (3) saline solution, (4) blood. (2) and (4) show bubbles of air. Wavy band is strip of adhesive. Time of exposure one second.

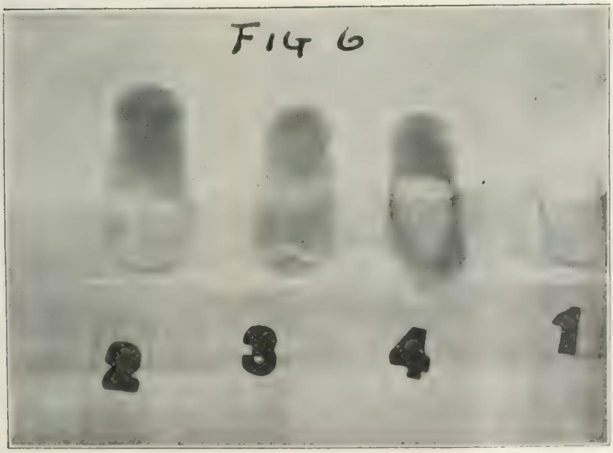
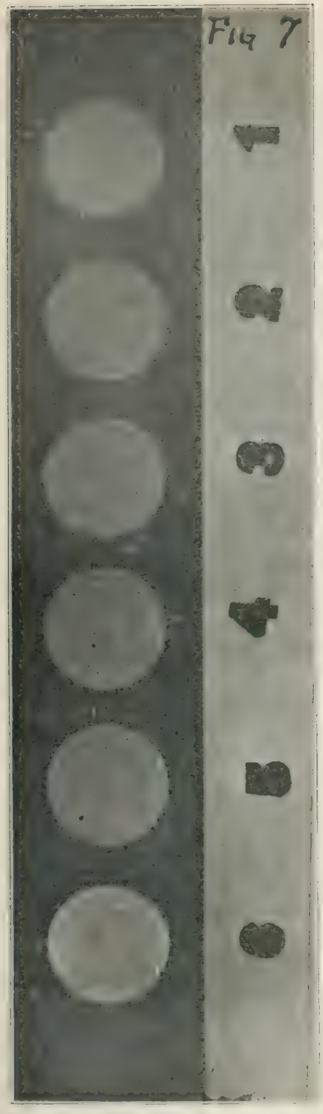


Fig. 6.—Skiagraph of gelatine capsules containing (1) air, (2) pus, (3) saline solution, (4) blood. (2) and (4) show bubbles of air. Wavy band is strip of adhesive. Time of exposure, two seconds.



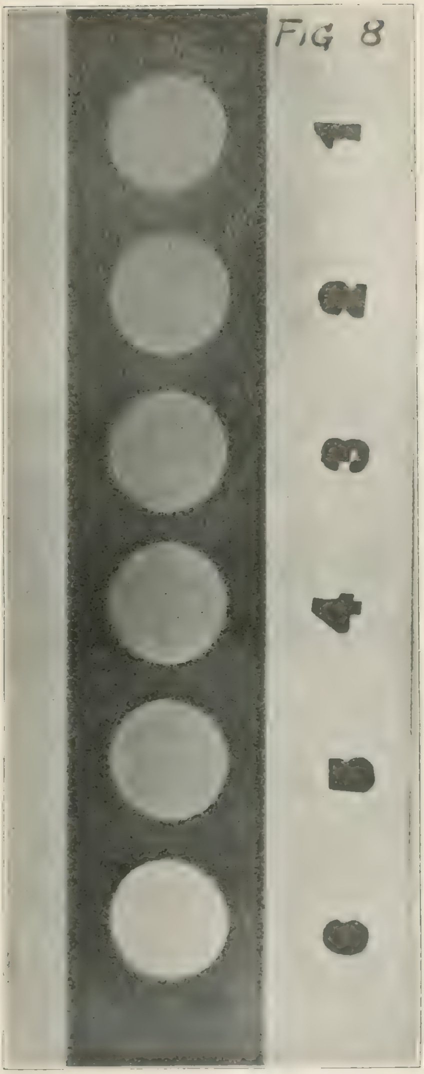


Fig. 7.—Skiagraph of receptacles in hard rubber, each containing two cc.'s of (1) gelatine, (2) pus, (3) blood, (4) saline sol., (5) water, (6) air. Time of exposure one-half second.

Fig. 8.—Skiagraph of receptacles in hard rubber, each containing two cc.'s of (1) gelatine, (2) pus, (3) blood, (4) saline sol., (5) water, (6) air. Time of exposure one second.

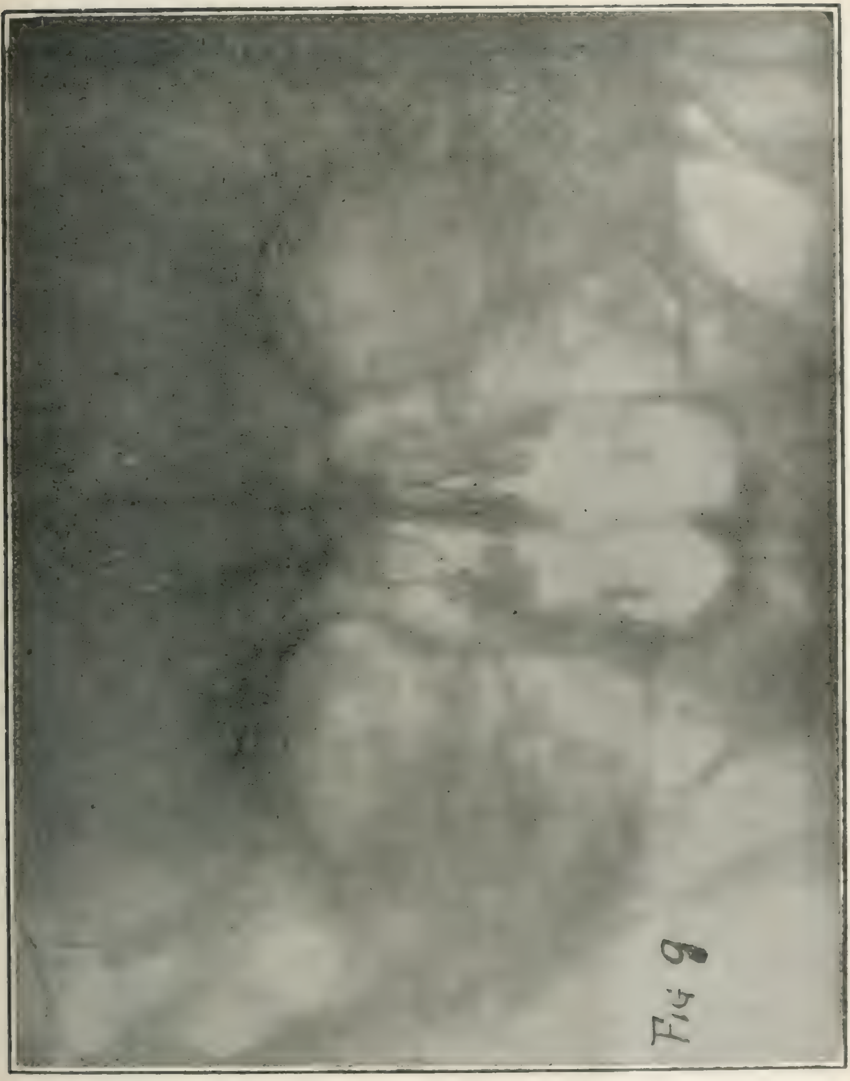


Fig. 9.—Skiagraph of head showing normal frontal sinuses, except that true bony septum is situated in what appears to be the middle of right sinus. Afterwards employed for gelatine injection. Time of exposure 30 seconds.

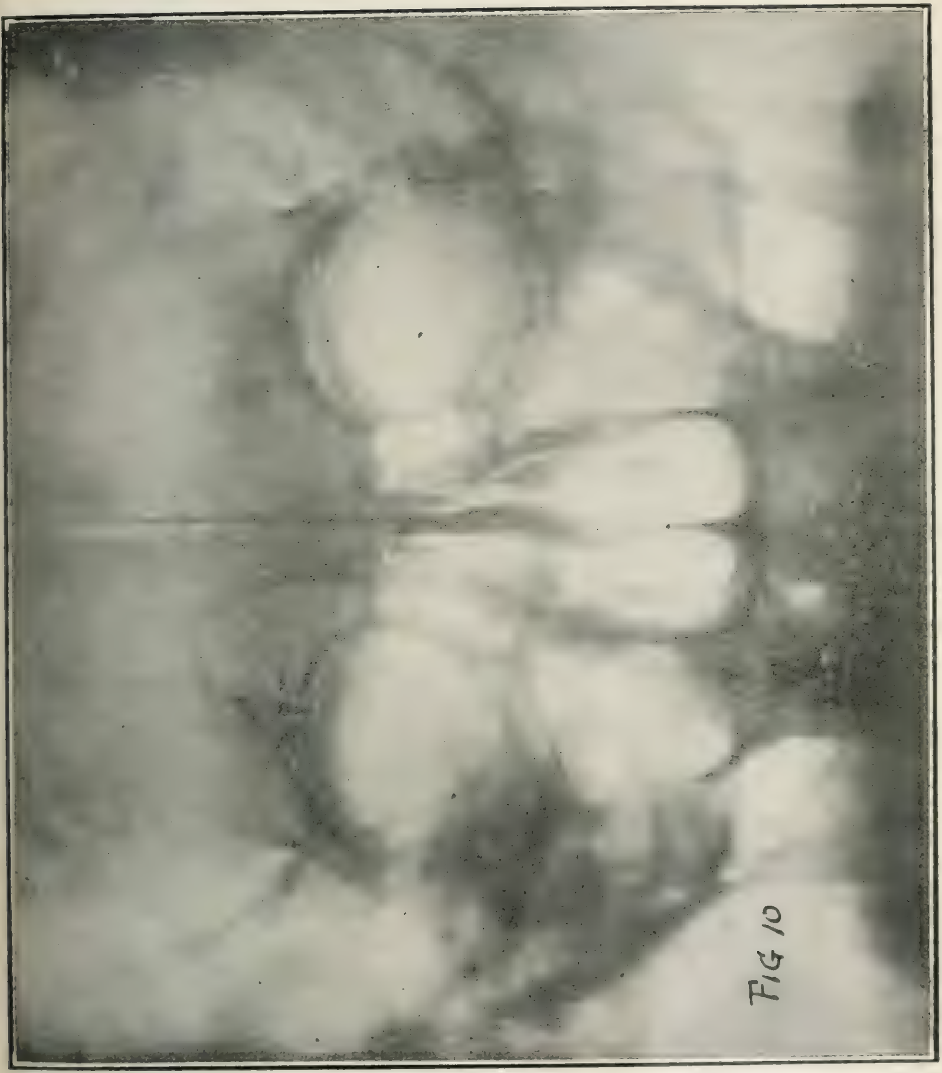


Fig. 10.—Skiagraph of head (represented in Fig. 9), showing large left frontal sinus filled with gelatine; small right sinus shows normal. Large left sinus extending far beyond median line is clouded and outline in distinct giving appearance identical with that of diseased sinus. Time of exposure 30 seconds.

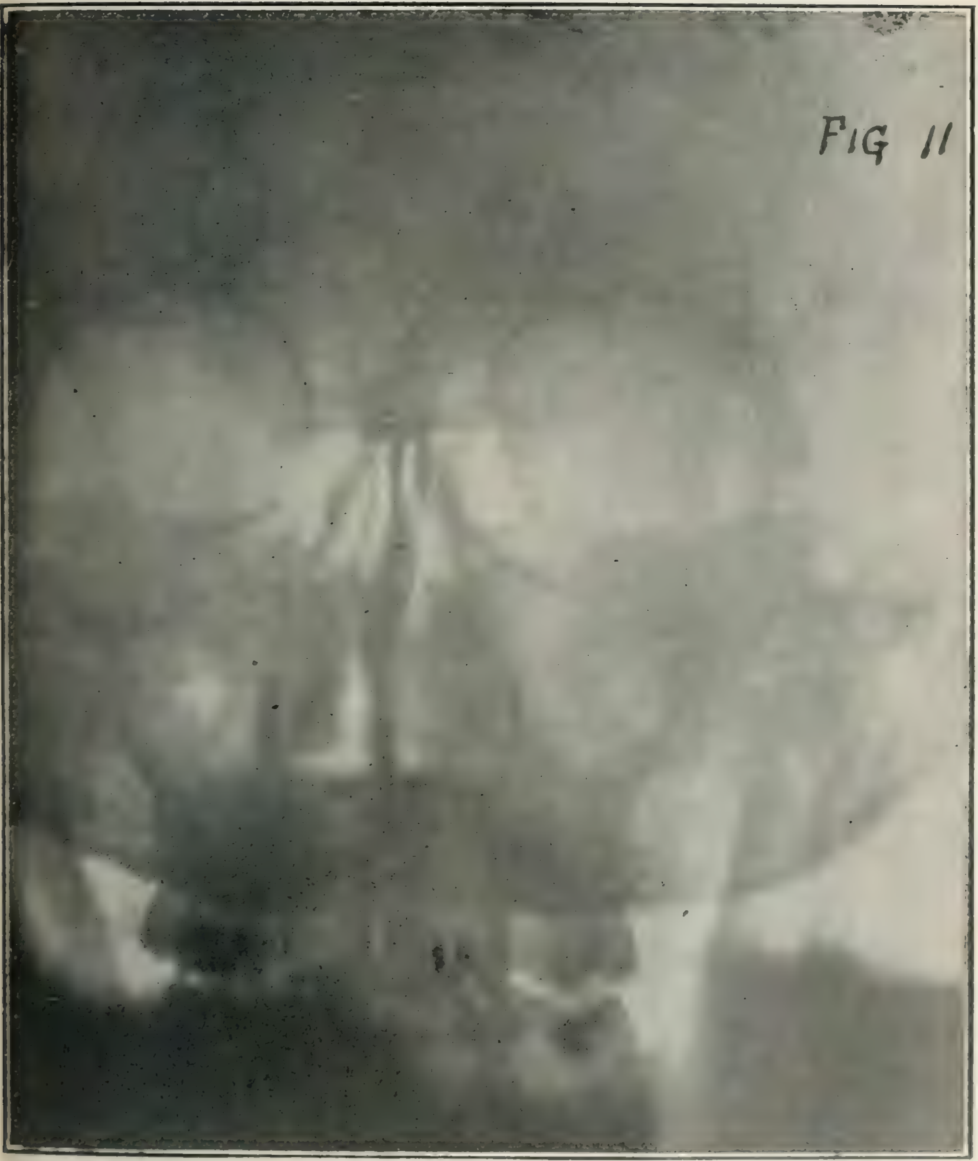


Fig. 11.—Skiagraph of head, showing right frontal sinus normal, left diseased. Verified by operation.

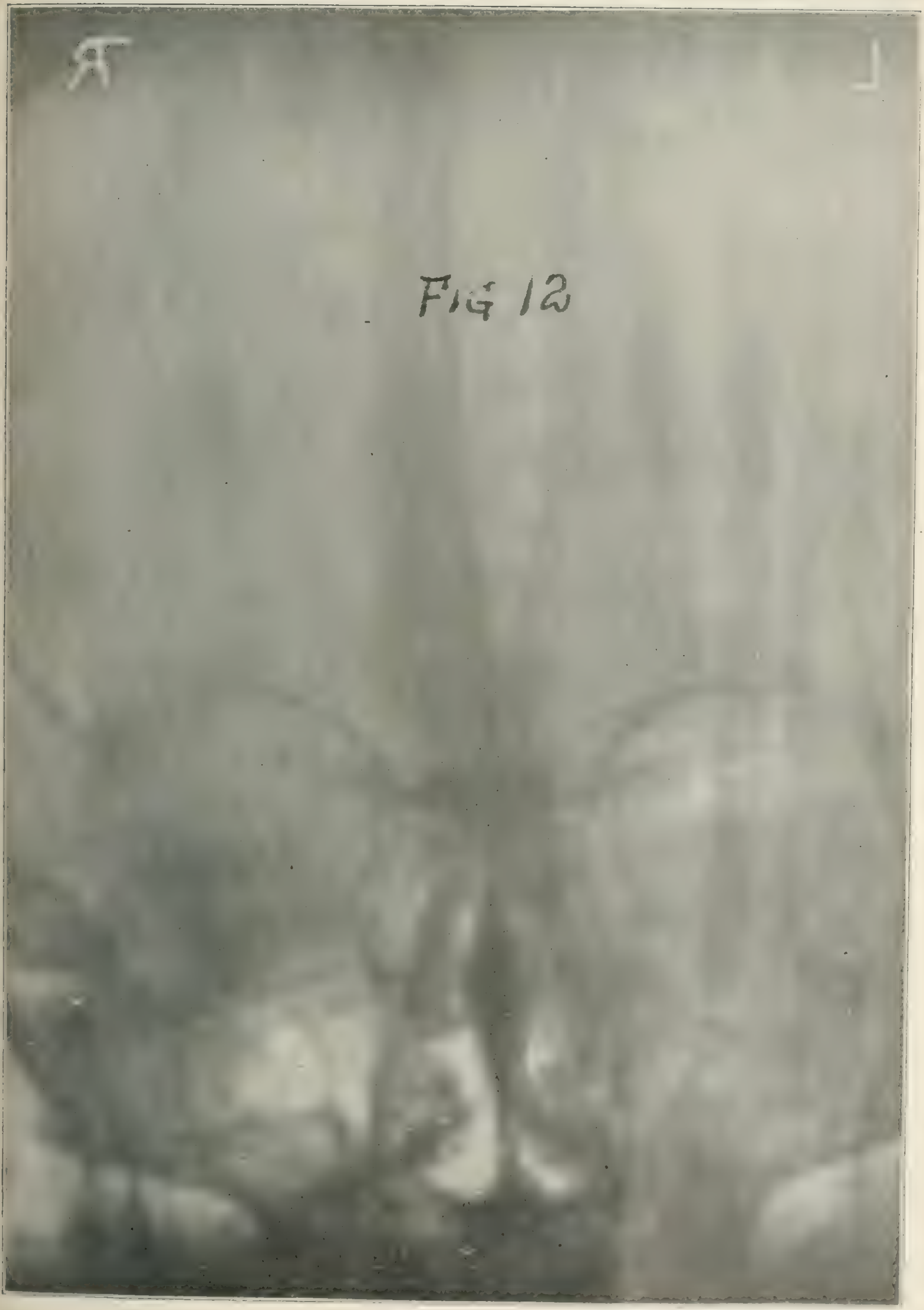


Fig. 12.—Skiagraph of head, showing small right frontal sinus normal; large left sinus extending far beyond median line is diseased. Verified by operation.

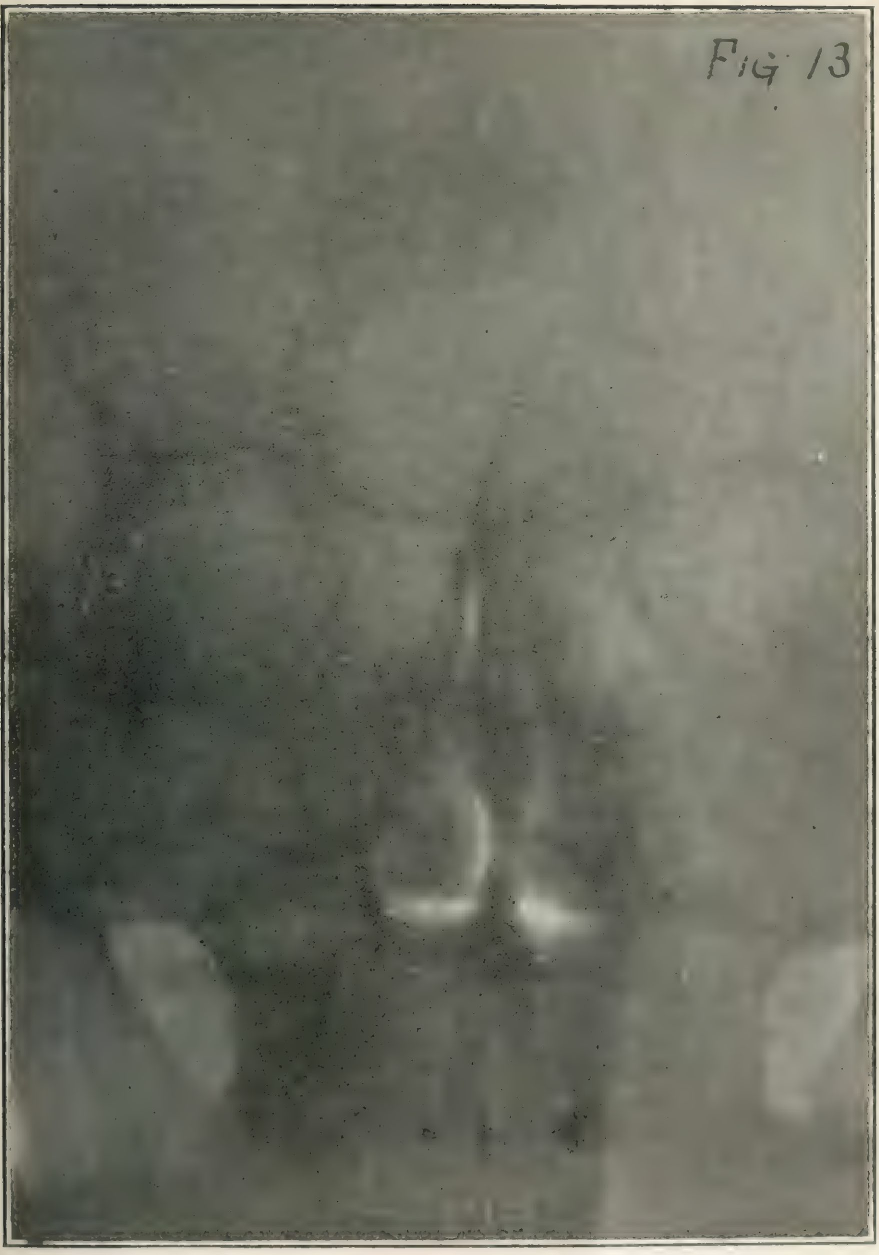


Fig. 13.—Skiagraph of head, showing right frontal sinus normal, left diseased. Verified by operation. Septum slants towards left.

Fig. 14.—Skiagraph of head, showing normal left sinus, right sinus diseased extending beyond middle line and high up. Verified by operation.

FIG 15

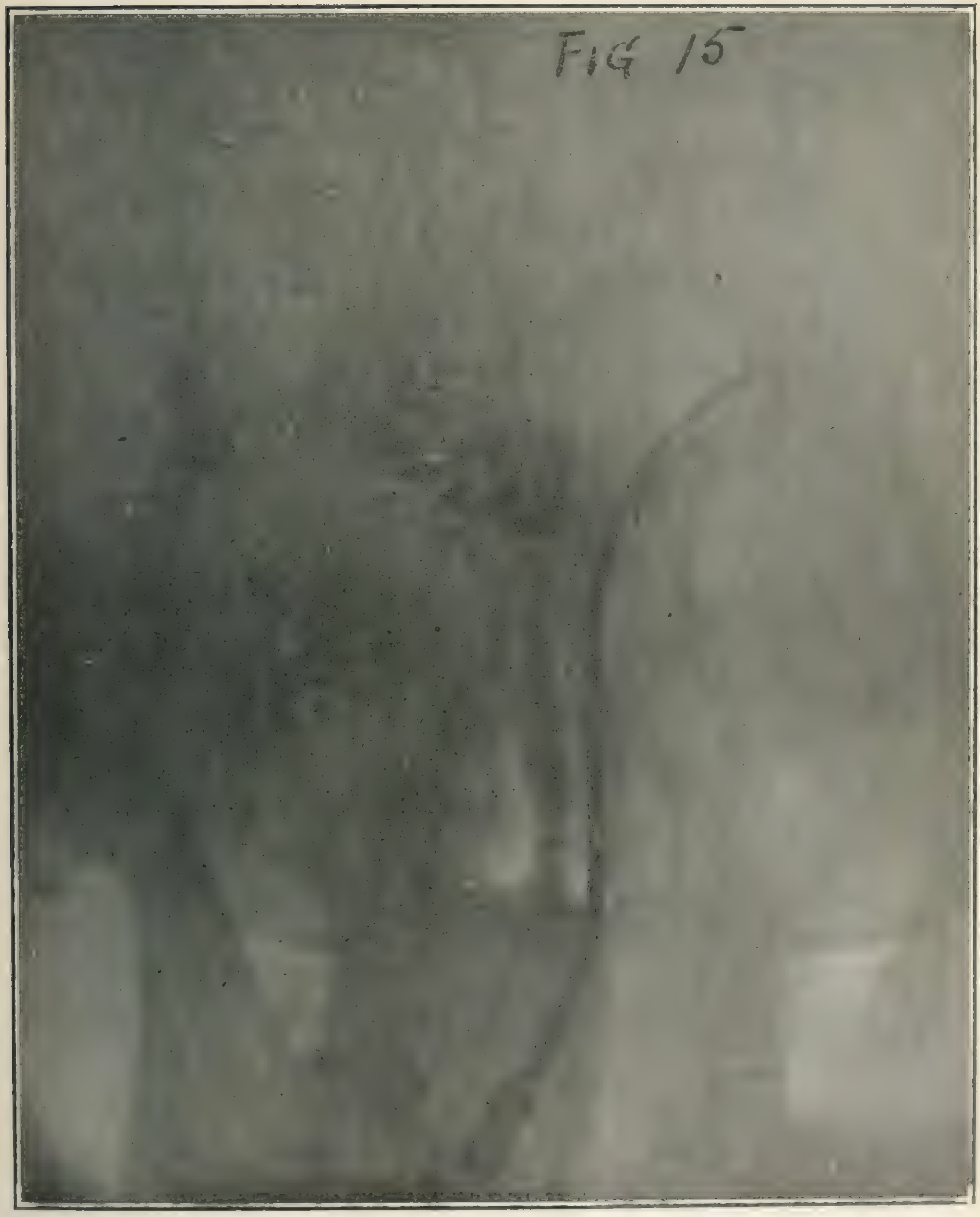


Fig. 15.—Skiagraph, showing frontal probe introduced into left frontal sinus. Right does not show having been previously operated upon, and obliterated by granulation tissue.

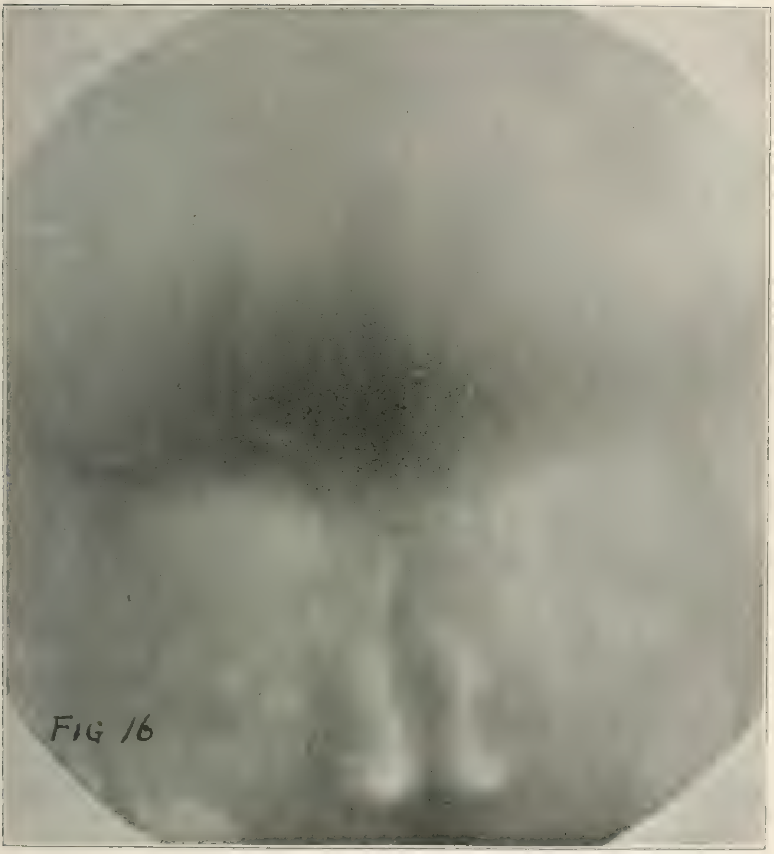


Fig. 16.—Skiagraph, showing absence of frontal sinuses.

LXXIV.

THE NASOPHARYNX AND THE THROAT IN THE DEAF MUTE.

By James Kerr Love, M. D.,

GLASGOW.

At first sight, a paper on the nose and throat in the deaf and dumb, however short, would seem unnecessary. Every otologist and rhinologist knows that the voice of the dumb is there and that the resonating cavities above the larynx will, if they are in health, modify the sound produced in the larynx, if only the deaf child can be taught to shape them properly,

On the other hand, unless the present writer interprets the signs of the times wrongly, we are on the eve of a revolution in the education of the deaf and dumb, and that revolution will be based on the examination of deaf mutes by the clinical observer.

At present there is no scientific classification of the deaf for educational purposes. In Germany all the deaf are taught to speak; in Britain, except as a mere accomplishment, only a small minority are taught speech; in America this speaking minority of the deaf is large but it is still a minority. And yet in these three countries, there is hardly any difference in the causes, the amount or the nature of the deafness which causes the dumbness. The state in Germany and the individual teacher in Britain and America settle the question of the deaf mute's education much as his religion and his politics are settled for him. Now, I have shown* that a careful clinical report made on the deaf mute after he has been a year in school will with scarcely any chance of error settle the method—oral and manual—by which he should be taught. Only in Denmark and Schleswig is any attempt made to classify deaf mutes scientifically, and although the clinical examination made there is somewhat primitive, it shows what may and must be done for the deaf before their education rests on any permanent or sound basis. Apart from the primary duty of fitting the deaf to earn a living, the first duty of those in charge of them is to give the blessing of speech to as many as are fit to use it. Now amongst the deaf in all countries, from twenty to thirty per cent hear and distinguish vowels, consonants or words when these are loudly spoken into one or both ears. These are the semi-deaf. A much smaller class, the semi-mute, hear nothing, but because they have lost hearing after three years of age, speak a good deal. Such are the semi-mute.

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*Deafmutism, 1896.

So far as the general health of the patient is concerned, affections of the nose and throat have the same significance and require the same management in the hearing as in the deaf child. But in those deaf mutes who have some remaining hearing and in those who have some remains of speech, such conditions have a special importance. In all countries, as above stated, there are about twenty to thirty per cent of such semi-deaf and semi-mute children, and all such children should be taught orally. Oral teaching will be much more successful if the resonating cavities in the throat and nose are cleared of obstruction. There is scarcely a deaf mute institution in the world where this is regularly and systematically done.

The extent to which post-nasal adenoids and enlarged tonsils exist amongst the deaf and dumb probably does not differ much from that to which it exists amongst hearing children. Ten years ago, the writer examined the ears and nasopharynx in 175 children resident at the Glasgow institution, and he found that 70 per cent had enlarged tonsils, post-nasal adenoids or both. In 33 per cent. these growths were very well marked and the disturbance of breathing, the interference with speech or the effect on the general health of the child warranted removal in all these cases.

During the last three years, a hundred children resident at the same institution have been examined with regard to their hearing by a continuous tone series of tuning forks, whilst at the same time the state of the pharynx and naso-pharynx has been carefully noted. Thirty-two children had tonsils or post-nasal adenoids, or both, so well marked that removal was, in the opinion of the writer, advisable.

In orally taught pupils, the nose and nasopharynx should be cleared whether the growths present are causing general symptoms or not.

The subject discussed is in one sense only a small part of a very large one—The Medical Inspector of School Children.—But it is a part with a special interest, and when combined with the examination of the eyesight and the hearing, the clinical examination of deaf children is charged with consequences far more important to the deaf-mute than the mere medical inspection of hearing children. The latter has for its objects the detection of infectious disease, the discovery of defects of sight and hearing, the prevention of overpressure, etc. But the clinical observation of the deaf-mute must do not only all that the medical inspection of the hearing child does, but must in time become the basis of classification which will decide the method of his education. It will show that whilst it is useless to attempt to educate an intellectually dull child, who is totally deaf. by the oral method, it is educationally a crime to neglect the hearing and remaining speech of the semi-deaf and semi-mute and to educate these by any but the oral method.

LXXV.

PERSISTENT UNILATERAL HEADACHE, DUE TO NEVOID CHANGES IN THE BONE OF THE MIDDLE TURBINAL BODY.

By Wyatt Wingrave, M. D.,

PATHOLOGIST TO THE CENTRAL LONDON THROAT AND EAR HOSPITAL.

The pathology of severe focal headache is always an interesting subject, and this case is recorded partly from its instructive morbid anatomy, but also because it affords an explanation for the frequent want of success in treating the middle turbinal body by cautery and local depletory measures for symptoms attributed to hypertrophy of that structure.

The patient, a healthy looking male, aged 38, sought relief for severe and persistent frontal pain of three months' duration, dating from an attack of influenza.

The pain was referred to the left supraobital and frontal regions extending to the vertex and occasionally to the corresponding eye. It varied in severity, but never left him and was at times so acute as to interfere with his clerical duties and to cause him much anxiety. There were frequent attacks of coryza, which generally afforded partial relief.

He had been an athlete, was of regular habits, temperate in tobacco and alcohol, but thought that he was gouty and had a tendency to piles. His only illness of any importance was influenza, of which he had experienced several attacks, the last one leaving a persistent nasal catarrh which had, however, nearly disappeared, but in spite of special treatment, the pain did not diminish.

Upon examination, the right nostril was found to be quite free, but the left breathway was distinctly less in volume, due in part to a slight septal deviation, but chiefly to a marked hypertrophy of the left middle turbinal, which completely blocked the upper meatus. Probing was very painful, but yielded no evidence of bone lesion, and there was no sign of pus. Under cocain, the turbinal became pale, but diminished only slightly in size. On transilluminating, although the maxillary and frontal sinuses were perfectly clear and symmetrical, it was felt that the unilateral pain, together with the tenderness and hypertrophy of the turbinal and the history, strongly pointed to some sinusal trouble, probably due to drainage obstruction.

Local sedatives, general depletion and bromides for a week affording no relief, the anterior end of the middle turbinate body was removed under alypin and adrenalin chlorid, by means of a Krause's snare, which cut through the bone with ease. This was followed by free hemorrhage, lasting about fifteen minutes, but the pain gradually ceased, and in the course of half an hour he left for home, perfectly comfortable. No discharge of any kind beyond bleeding attended or followed the operation, and subsequent probing revealed no evidence of sinusal abnormality. He made a rapid and complete recovery, and six months later reported that he had experienced no return of the pain and enjoyed complete freedom from any "running" from the nose.

The part removed was about the size of a large haricot bean, measuring 15x12 mm. On microscopic examination, the mucous membrane appeared normal, but the bone cancelli were found to contain very thin vessels, distended with blood and pressing on the walls. There was no evidence of lymphocyte infiltration or osteoplastic activity, such as is usually found in inflammatory sinusitis involving the bone. The distended vessels had extremely thin walls, consisting only of epitheloid cells, in striking contrast with the arteries which in some of the adjacent cancelli were quite normal. The condition which is strongly suggestive of a nevoid state, differs entirely from cavernous distension of the erectile tissue so common in the inferior turbinal which involves the mucous membrane only and not the bone.* Part of the bone was pneumatic and lined with normal membrane continuous with that of the ethmoid cells, a condition often found in hypertrophy of this part.

Although a moderate degree of congestion, both periosteal and endosteal, is often seen in sections of removed middle turbinals, in this case it was exceptional, and taken together with the striking coincidental disappearance of symptoms on removal, it may reasonably be interpreted as possessing a causal relationship. The morbid changes may be regarded as a nevoid condition of the spongy bone, possessing no resemblance whatever to any inflammatory process, such as rarefying ostetis, necrosing ethmoiditis, suppurative sinusitis, etc.

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*Lancet, June, 1894. Turbinal Varix.

The association of the middle turbinal body with headache and many reflex phenomena is familiar to all rhinologists, likewise its anatomic relation to the hiatus semilunaris, which plays so important a role in the drainage of the accessory sinuses, but in the former connection, treatment has been chiefly confined to cautery and other local applications to the mucous membrane only, while removal of the anterior end, including the subjacent bone, generally forms part of the radical treatment of the sinuses. The morbid anatomy of this case illustrates the uselessness of confining treatment to the mucous membrane only, which having already failed, considerably influenced the adoption of a more radical course.

The operation is extremely simple, there being no necessity for the use of punch-forceps, scissors, etc., when the turbinal is sufficiently prominent as to require removal. A strong and fine wire should be used, and if well pushed upwards and backwards, will readily engage and rapidly cut through both bone and mucous membrane. Care must be taken to avoid (1) simply stripping off the mucous membrane and soft parts, (2) not to exert any dragging or tearing force, since in patients over the age of 40 the ethmoid bone is so spongy and "biscuit-like" in consistence as to be extremely brittle. This remark also applies to the removal of polypi in old people in whom the osteoporotic changes in the ethmoid are well marked.

LXXVI.

THE ETIOLOGY OF HYPERKERATOSIS OF THE TONSILS.

By Geo. B. Wood, M. D.,

PHILADELPHIA.

In the consideration of such a time-worn subject as "Hyperkeratosis of the Tonsillar Tissues of the Throat," it is not necessary to review the great quantity of literature which has been written on this subject. I might, however, call attention to an article by Sendziak, published in the transactions of the American L. R. & O. Society for 1905. In this article, Sendziak carefully reviews the greater part of the literature from Fraenkel up to the writing of his article. His conclusions are in accord with the original idea of Fraenkel; namely, that a specific infection by the leptothrix is the important etiologic factor in the production of this peculiar condition of the tonsils. It seems to me most unfortunate that such a view of the etiology of hyperkeratosis of the tonsillar tissues has been so recently resurrected. I had thought the idea of a specific relation between the leptothrix and this disease had been so firmly buried by Siebenmann and others that all thinking laryngologists had come to believe that the leptothrix was present purely as a saprophyte. There is a rather acute infection of the throat in which the leptothrix is probably the exciting cause. This infection, however, is not limited to the tonsillar tissues, but may occur in any portion of the body where the vital resistance has been lowered and the leptothrix organisms have gained access.

But because the leptothrix is a common inhabitant of the mouth, the throat is more frequently infected than are the other portions of the body. The clinical picture of the infection, however, is absolutely different from hyperkeratosis of the tonsils. Any part of the throat may be infected. There is an acute inflammatory reaction usually accompanied by a milky membrane, which may or may not leave a denuded surface on being detached. Also, there is very apt to be infection of the cervical lymph glands. The condition is easily cured by the ordinary throat washes and runs an acute febrile course.

Hyperkerastosis of the tonsillar tissues of the throat is a disease, or better, a condition characterized by the appearance of numerous white projections, not only from the cryptal orifices of the tonsils proper, but also from the orifices of the lymph follicles on the posterior and lateral pharyngeal walls and on the lateral glossoepiglotidian folds. This condition does not occur on portions of the throat where there is no lymphoid tissue. The lymphoid tissue of the upper respiratory tract, however, is so ubiquitous that occasionally we may see these little white projections on almost any part of the mucosa. In the large majority of cases, the condition is limited to the faucial and lingual tonsils. That it reaches its

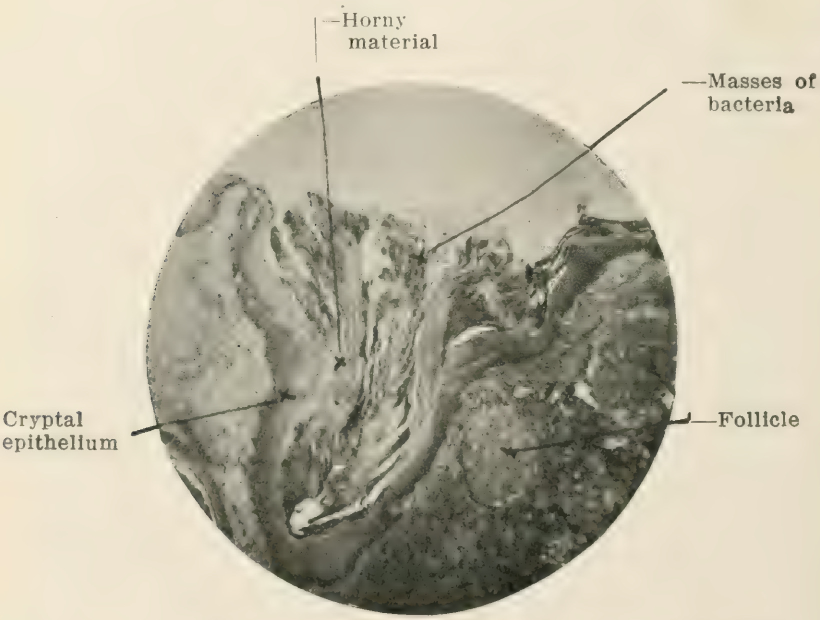

Fig. 1.—Hyperkeratosis. Showing the typical appearance under low power. The horny mass is growing from a comparatively small area of the cryptal epithelium and the plug shows the ordinary fraying of its edges.

greatest development at base of the tongue and at a position just behind the lateral glossoepiglotidian folds and the posterior part of the inferior poles of the tonsils, is due, almost entirely, to mechanical reasons. The contractions of the muscles during swallowing prevent food from coming in intimate contact with the surface of these parts, and, therefore, permit the projections to grow undisturbed. Although the horny material is quite resistant to trauma, the bacterial accumulations which form the greater mass of the projections are easily brushed off, so that the size of the growth is much greater where it can be protected from mechanical disturbances.

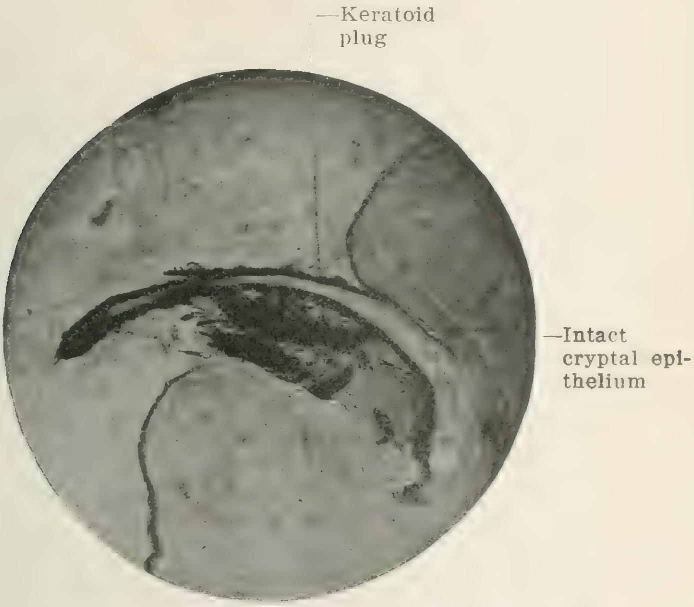

Fig. 2.—Hyperkeratosis, faucial tonsil. This specimen was from a case which had been vigorously treated with antiseptics. There are practically no micro-organisms. The black staining is due to nitrate of silver which had been used in treating the patient.

The symptoms caused by this condition of the throat are either entirely wanting or very slight and due for the greater part to the local irritation of the hard, horny plug. If they project from the base of the tongue so as to come in contact with the epiglottis there will probably be an irritating tickling sensation, causing a hacking cough. If they are so placed as to be compressed during the act of swallowing, they may give rise to a slight sticking pain. Occasionally, among the rich and varied bacterial flora which grows in such luxuriance on this horny material, there may lurk a germ possessed of more or less pathogenic power which can set up an accompanying inflammatory reaction in the tonsil or surrounding structures. Hence, the relation which some observers have noticed between acute tonsillitis and this disease.

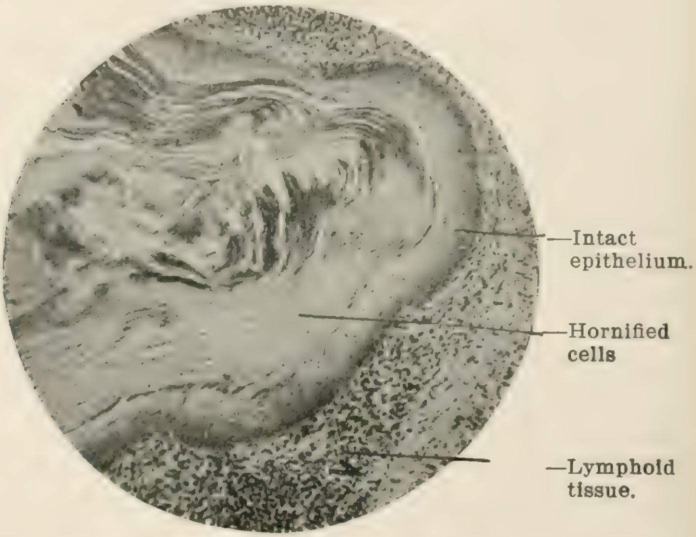

Fig. 3.—Hyperkeratosis. Cross section of a crypt filled with keratoid material and bacteria.

To understand correctly the pathology and also the etiology of lacunar hyperkeratosis, we must turn our attention for a few moments to the anatomy of the normal active tonsil. The tonsil consists of four chief elements: the connective tissue, the germinating follicles, the interfollicular tissue and the crypts.

First: The connective tissue, that is, the trabeculae and reticulum, acts as a supporting framework to the tonsil substance proper. The trabeculae carry the blood vessels, the nerves and the lymphatics.

Second: The germinating follicles are the centers wherein the large mother cell of the leucocytic group undergoes karyokinesis and forms young lymphoid cells.

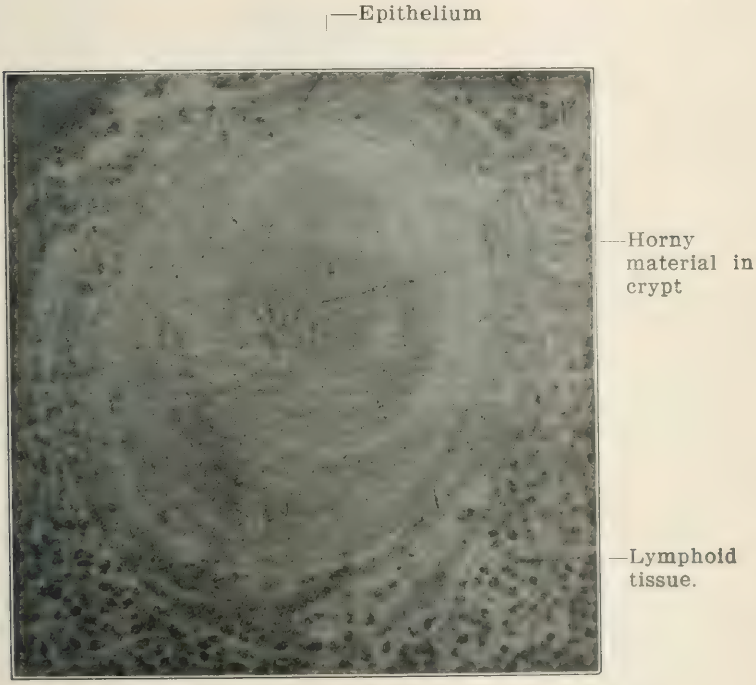

Fig. 4.—Hyperkeratosis. Cross section of the terminal portion of a crypt, showing the concentric arrangement of the layers of horny material and the epithelium, which is still somewhat disintegrated.

Third: The interfollicular tissue is made up of lymphoid cells in various stages of development. The cells making up this interfollicular tissue differ in size and shape according to their location. They are greater in number around the follicles, and show greater difference in their anatomic construction in the immediate neighborhood of the crypts.

Fourth: The crypt of the tonsil is its peculiar and most characteristic structure. It consists of an invagination of the epithelium from the surface of the tonsil, which has undergone a very interesting anatomical change. In the first place the subepithelial connective tissue which exists in a marked degree beneath the surface epithelium, disappears as soon as the epithelium starts to form the crypts. This permits the epithelium to come in direct contact with the lymphatic structure of the tonsil, and very frequently it is impossible to distinguish a dividing line between the epithelium of the crypt and the interfollicular tissue. The epithelium of the crypt, unlike its progenitor which covers the surface of the tonsil, does not form a compact, unbroken barrier of protection. For the greater part of its extent it presents an intact line, only one or two or possibly three cells in thickness. Toward the parenchyma, the epithelial cells show a peculiar condition. They are separated from each

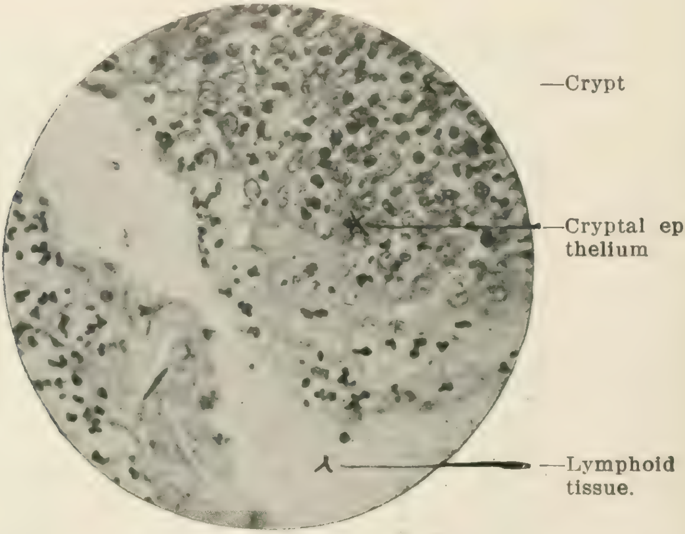

Fig. 5.—Hyperkeratosis. The epithelium here represented still retains its normal rarification, though in other portions of this same crypt there was typical hyperkeratosis. Numerous polymorphonuclear leucocytes are passing through the epithelium.

other by interposed cells varying in type from slightly changed epithelial cells to a well-formed lymphocyte. Also, the epithelial cells may extend from the crypt into the tonsillar substance, suggesting the ramifications of a malignant epithelioma. The smaller terminal invaginations of the cryptal epithelium are usually solid sprouts, frequently with central keratosed cores. The lumen of the crypt is formed by the subsequent exfoliation of the keratosed cells.

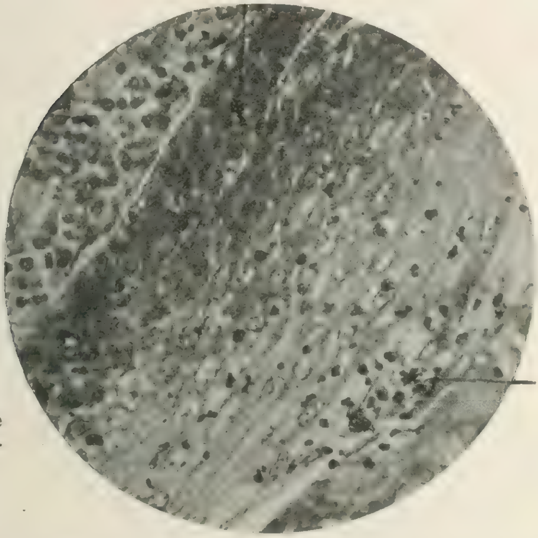
Lymphoid tissue
Epithelial cells, still retaining their normal absence of compactness.
—Polymorphonuclear leucocytes.

Fig. 6.—Hyperkerasosis. Showing polymorphonuclear leucocytes passing through the epithelium. This micro-photograph shows the cryptal epithelium beginning to lose its physiologic activity.

Turning now to hyperkeratosis, we find the epithelium of the crypts showing characteristic changes. In hyperkeratosis the epithelium loses its rarified condition and becomes an ordinary pavement, squamous epithelium similar to that covering the surface of the tonsil, except that generally it does not show the connective tissue papillae. The crypt of the tonsil is markedly dilated and filled with a horny mass, which merges at various points into the epithelium, though in sections stained with eosin and thionin there seems to be a more or less distinct line where the epithelial cells become keratosed. The living cell has a nucleus well stained with with thionin, and its protoplasm is of a purplish color due to the mixed staining with eosin and thionin. The keratosed material stains only with the eosin and is, therefore, of a bright pink color. Occasionally, in the keratoid mass, a very faintly stained nucleus will be found indicating that the material of which the mass consists has been originally derived from epithelial cells. According to the mechanical circumstances by which the tonsil is surrounded, the horny mass becomes sooner or later broken up into layers between which multiply and grow organisms of all varieties. This fraying of the cryptal plug may take place within the crypt itself so that the resulting fissures permit the bacteria at times to penetrate almost but not quite to the living epithelium. Mitotic figures may be seen in the epithelium at different places, but especially along the border toward the parenchyma of the tonsil. The epi-

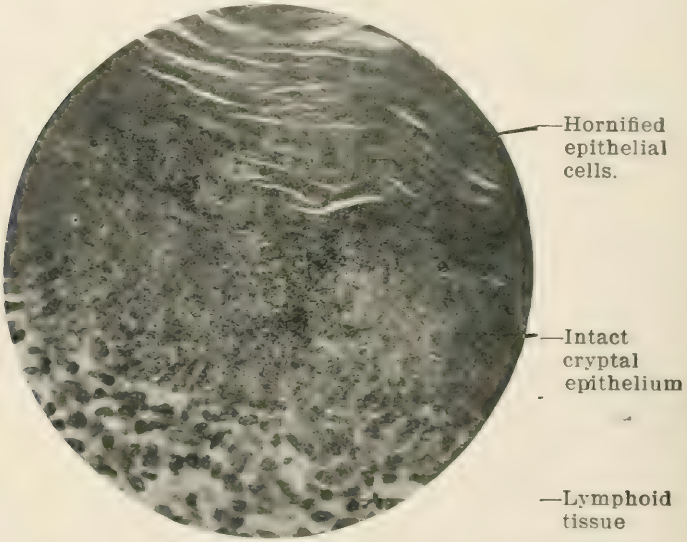

Fig. 7.—Hyperkeratosis. Section through the cryptal epithelium, showing the formation of the keratoid mass from the epithelial cells.

thelium is, therefore, in a state of active growth. This eccentric growth, however, which results in the formation of the keratoid plug is not equally distributed to all parts of the epithelial lining of the tonsillar crypts. Take, for instance, a single individual crypt; a portion of the epithelium may still persist in its normal condition of rarification without a discernible border line between it and the tonsil parenchyma; in another part the epithelium may exist simply as a barrier of cells with a very thin layer of subepithelial connective tissue, and again in the same crypt we may see the hyperkeratosis in its most beautiful and characteristic appearance.

This change in the epithelium of the crypts is the characteristic pathologic feature of hyperkeratosis. Besides this there are generally other changes in the tonsil. The connective tissue is usually increased in amount, the trabeculae are thicker and in some cases the subepithelial connective tissue extends from the surface epithelium for quite a distance down along the crypt. The follicles are small and much less numerous and the surrounding zone of lymphocytes has become comparatively insignificant. The mitotic figures in the follicles, though present, are less numerous and the whole aspect of the organ is one of suppressed activity. We find, however, sometimes signs of local irritation in the immediate neighborhood of the crypts, as evidenced by the outwandering of polymorphonuclear leucocytes from the capillaries and their penetration between the cells of the cryptal epithelium. This irritation is easy to understand when we consider that the crypts contain large numbers of saprophytic and probably also pathogenic micro-organisms growing actively and receiving their nutriment from the accumulated keratosed cells. The toxins elaborated by these organisms must be absorbed to a greater or lesser extent by the tonsillar tissue. It is probably due to the fact that the cryptal epithelium has lost its normal physiologic rarification and has become an impact protective barrier that a more noticeable reaction is not a common result.

In a paper published last fall on the "Functions of the Tonsil," I endeavored to show that the epithelium of the crypts was in a state of active growth and that the epithelial cells were undergoing a metamorphosis, the result of which was the formation of lymphoid cells. Since then further study on the subject has increased my belief in this theory, especially as I have been able to demonstrate that the cryptal epithelium of the normal tonsil shows a sufficient number of karyokinetic figures to indicate a rapid growth. At the time of the publication of my paper, I did not believe that mitotic figures could be found in the epithelium of the deeper portions of the crypts, but other phenomena suggesting rapid increases were so noticeable that I concluded that the cells were undergoing a mitotic division. Recently I have seen in undoubted epithelial cells numerous mitotic figures showing all the stages of karyokinesis. The phenomena which previously led to the belief that the epithelial cells of the crypts were in a state of active growth, was the constant finding of keratosed and desquamated cells in the lumen of the crypts and the penetration of the deeper cells of the epithelium into the interfollicular tissue. In some forms of hypertrophied tonsils this penetration reaches such a high degree that the epithelium may almost completely surround some of the germinating follicles.

It is scarcely convenient in this paper to reiterate the various reasons why I thought the epithelium of the crypts of the tonsils was a primogenial source of lymphocytes, and it may be that until this metamorphosis can be proven as clearly as that one and one make two, the majority of anatomists will be inclined to doubt its possibility. For the purpose of this paper the proof of this metamorphosis is not absolutely necessary, but I desire to emphasize the fact, namely, that the cryptal epithelium in the normal and hypertrophied tonsil is for some reason or other in a state of active growth.

Several years ago I made the statement concerning the etiology of hyperkeratosis of the tonsillar crypts, that the increased growth of the epithelium forming the keratoid plug was probably due to a low grade inflammatory condition of the tonsillar parenchyma. I based this erroneous idea on the following rather peculiar phenomena: In the removal of a portion of a tonsil by an instrument, such as the tonsillotome or snare, which compresses the organ at the line of the separation, there will be found near the line of removal numerous elonged nuclei closely resembling leucocytes in an active state of diapedesis. At that time I believed that these compressed leucocytes were the result of some chemotactic attraction, and hence indicative of inflammation. As there were no other inflammatory changes, I concluded that the inflammation must be of a low grade. Since that time I have been convinced that these peculiar elongated cells are the direct result of mechanical compression either in the removal or handling of the specimen. On the other hand, the tonsils showing hyperkeratosis of the crypts are almost always small and more or less atrophied, and under the microscope show an increase in the connective tissue with a decrease of lymphoid tissue and secondary follicles, so that we have a picture of functional quietude.

The functional activity of the tonsillar epithelium (permitting me to reiterate) is growing both superficially and internally. Now it is conceivable that if an organ with a peculiar physiologic growth manifested in two directions is for some reason deprived of its ability to increase centrally, it may double its growth peripherally. In other words, suppose the cryptal epithelium has ceased to penetrate into the parenchyma of the tonsil, its tendency toward growth causes an increased output of superficial or keratosed cells. Again, the disintegration of the epithelium permits an outpouring from the tonsillar parenchyma of numerous leucocytes, and probably more or less fluid secretions which, mingling with the accumulating epithelial cells, cause their disintegration and consequent exfoliation. When the physiologic activity of the epithelium has ceased, the epithelial cells revert to their original type and form an intact squamous pavement epithelium. The extravasation of leucocytes and fluids through this intact epithelium is rather difficult, and the growing superficial cells can accumulate in the crypt until a greater or smaller mass of keratoid material is formed.

This, then, is the raison-d'etre of hyperkeratosis of the lacunae of the tonsillar tissues of the throat, namely, a decreased functional activity of the tonsil while a portion of the cryptal epithelium still possesses its physiologic tendency toward growth.

It must be admitted that this theory is more or less open to criticism, because there are certain happenings regarding this peculiar condition which are somewhat difficult to harmonize. If this condition is due to decreased functional activity, why is it that tonsils generally atrophy without more manifestation of a hyperkeratosis? The vagaries of life are so great and so numerous that it is always easy to hide unexplainable phenomena under the cloak of life's mysteries, and

I understand that in a scientific article one can scarcely be excused for seeking such a refuge. Such is the case, however, and I must be pardoned for being unable to explain why the epithelium of some tonsils retains a portion of its physiologic property, while losing the remainder, just as I cannot explain why one individual is practically immuned from small-pox while another is most susceptible. It may be that the influence of certain toxins, possibly of microbic origin, exerts just the proper amount of stimulation which the epithelium requires for increased growth, or it may be something else, but to me it seems much more probable that hyperkeratosis of the tonsillar crypts is a pure vagary of function on the part of the epithelium of the tonsillar lacunae.

The facts and theories which have just been advanced would indicate the uselessness of any local treatment other than the destruction of the tonsillar crypt, and clinical experience bears out this view. Almost all of these cases after a period varying from a few months to a year or more, tend to recover spontaneously. Further, the condition is generally seen at that time of life when the tonsils are atrophying, and in a large majority of cases the size of the afflicted tonsil is already insignificant.

In conclusion, I want to place particular emphasis upon the importance of disassociating the leptothrix or any other micro-organism from an etiologic relationship with lacunar hyperkeratosis of the tonsils. It would be as rational to hold the grime and dirt of a miner's hand responsible for the production of the horny layer of the skin as it would to believe that the saprophytic leptothrix is the causative element in the production of what is really a calloused tonsil.

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LXXVII.

LARYNGEAL PHLEGMON.

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CHICAGO.

It might occur to the reader's mind, after having perused this thesis, that a more adequate title would have been "Infectious Phlegmon of the Pharynx and Larynx" than the one chosen for it. Primary laryngeal phlegmon is a very rare occurrence, the laryngeal process being nearly exclusively secondary to pharyngeal phlegmon, and in reviewing the literature on the subject, that relating to the pharynx is so closely intermingled with that relating to the larynx that the two can scarcely be dissociated. Another phase of the question is as to the identity of phlegmon and erysipelas in these regons. Those of us whose memory runs so far will remember the voluminous and, in some quarters, rather acrid controversy which followed the appearance of Senator's paper in 1888.

The writer's position in the present thesis is the one maintained by Küttner, Beckhäler, Onodi and others, namely, that although phlegmon and erysipelas may be etiologically identical, and, as they affect the larynx, nearly always secondary to pharyngeal involvement, practical points of difference in pathology, prognosis and treatment give ample reason for separating them and considering primary laryngeal phelgmon as a clinical entity. Up to the comparatively recent past, the non-inflammatory edema of the larynx which occurs in nephritis, cardiac affections, etc., has been grouped with erysipelas and phlegmon; now we not only distinguish a difference between those edemas and the edema of infectious, inflammatory nature, but we distinguish between non-inflammatory edema, as it occurs in cardiovascular diseases, and edema of angioneurotic nature, under which head may be placed those edemas which occur after the administration of kalium iodid.

The history of the development of our knowledge of these conditions may be divided into two periods: the prelaryngoscopic period, and the period since the discovery of that valuable instrument. Since Hippocrates, it has been regarded as "a good indication when erysipelas spread from within outward, and a bad sign when it spread from without inward." This retropulsion was studied more fully by later day writers, especially by Fabrizio D'Aquapendente, who presaged the theory of metastasis, but no especial mention is made of erysipelas of the pharynx or larynx until the eigtheenth century. Dareac observed and gave a fairly clear description of a fatal case of erysipelas of the pharynx which occurred during an epidemic of erysipelas in 1757. After an interval of more than a half century, Bayle, Bouillaud, Cruveilhier, Sestier, Radcliffe, Ryland, Porter, Mackenzie and others published observations which gradually established the separation of inflammatory edemas of the larynx and pharynx. In 1885, Massei published his reports of fourteen cases of primary erysipelas of the larynx, and three years later (1888) Senator published his contribution on "Acute Infectious Phlegmon of the Pharynx." Both of these observers were anticipated by other authors; for example, Massei by Cuire in 1864, and Porter in 1874, who observed a case of fatal primary erysipelas of the larynx at the London Hospital; Senator by Cruveilhier and Bergen; nevertheless, both papers mark milestones in the advancement of our knowledge of the subject. The controversy as to the phlegmonous process being identical with erysipelas of mucous membranes began with the discussion following Senator's paper, and has lasted to the present time.

Etiology.—In so far as both erysipelas and phlegmon are caused by streptococcus, they are identical (B. Fraenkel). Lately, however, there is a strong tendency on the part of bacteriologists to believe that there are different kinds of streptococci which are morphologically alike. It would seem as though this must be so when we consider the vast difference in the effects the various streptococci produce on the organism: in one case producing a localized abscess; in another a plastic inflammation of the submucous tissue with comparatively slight systemic manifestations, ending without the formation of pus in recovery; in another, infiltration, necrosis and suppuration accompanied by grave systemic symptoms, sweeping on irresistibly to death. Or does the difference in virulence depend upon the condition of the individual's cellular elements, or in the serum as manifested in the opsonic index? Future research must determine these matters. In all probability these micro-organisms are normally present in the buccopharyngeal cavity.

The portal of most frequent entrance in primary laryngeal phlegmon is the region of and about the epiglottis. Massei's experience leads him to regard the lingual tonsil as the most frequent point of entrance in laryngeal erysipelas. Not only is the epiglottis the point most exposed in the respiratory current, but on account of its prominence and position it is peculiarly subject to chemic, thermal and mechanical insults, incident to deglutition.

No age is exempt, an infant eleven months old and a woman of eighty years appearing in the reports of cases. As to sex, there is some doubt. Gerber collected thirty-three cases, presumably of acute laryngeal phlegmon (though he does not specify), in which twenty-three males and ten females were affected. Occupation bears a marked relationship to its etiology; those who come in contact with septic processes, such as nurses and patients confined to septic wards, are especially liable to acute infectious processes in the pharynx and larynx (Porter).

Pathology.—In the swelling caused by erysipelas of the larynx, cellular infiltration occurs to such a slight degree as to be relatively unimportant. In phlegmon, infiltration plays a most important role. In erysipelas, the cellular elements of the tissues remain intact. In phlegmon, from the very beginning of the process, necrosis is marked (Virchow). It is possible for the former process to pass into the latter and to have mixed forms (Bryson Delevan, Baruch, Henning and others). But this does not militate against the necessity of keeping the two separated because of practical clinical utility. Further, the edematous swelling of erysipelas may be readily resorbed and leave no lasting effect on the tissues. Tissues that are the seat of phlegmon, on the other hand, especially as it affects the larynx, are rarely restored to their integrity, but are replaced by scar tissue.

It is in the course of the two forms that dissimilarity is most marked. In erysipelas, the greatest danger is asphyxia. The systemic factors are relatively negligible, and if by intubation or tracheotomy the respiratory function can be maintained, a reasonable hope of recovery may be entertained. In phlegmon, the systemic factors are by far the most dreadful, and in the majority of cases death from heart failure and pulmonary edema (sepsis) occurs before critical dyspnea appears. The former remains a local disease, which affects the organism as a whole principally through the absorption of the toxins from the original nidus. In the latter, septicopyemic infection of trachea, bronchi, lungs, pleura, pericardium, spleen, kidneys, etc., is found on section to be the rule.

Their initiatory symptoms are similar. Both begin suddenly, frequently inaugurated by a chill, and followed by a high fever. According to Gerhardt and Zeigler, a prodromal fever is characteristic for erysipelas, which occurs twelve hours before the subjective sensation and twenty-four hours before the objective appearances. Dysphagia, which early becomes lancinating, appears, so that the patient expectorates the buccal secretions rather than swallow them. The voice may or may not be quite hoarse or only clouded. Early dyspnea supervenes in erysipelas, often within a few hours. Not so in phlegmon, which may proceed to a fatal issue without imminent danger of suffocation occurring. On the other hand, the sensorium is more liable to be affected, somnolence, delirium. In both, pain is caused by pressing on or moving the larynx. The cervical lymph nodes are early involved, and swelling of the neck is more liable to be an early symptom in phlegmon. Inspection of the pharynx in primary laryngeal phegmon gives no clue to the situation of the disease. The mirror usually shows in erysipelas an epiglottis red, erect and glistening (Barnes), which may obscure the view of the rest of the larynx. This same character of swelling extends to the aryepiglottic folds and false cords, but the interior of the larynx can rarely be seen. In phlegmon, the laryngoscopic picture is quite different. In the early stages it frequently presents the same appearance as early tuberculosis (Sokalowski), and later may present the appearance of a ruptured dermoid cyst. Here we have infiltration and the swelling is not so great. In erysipelas, the swelling is much more marked in comparison to the duration of the disease, and is edematous. In erysipelas, the color of the swelling is more of a livid bluish tone; that of phlegmon a waxy, pinkish gray. The surface in erysipelas is smooth, glassy or glistening; in phlegmon dull, lustreless and minutely roughened and flecked with mucopurulent discharge. The wandering character of erysipelas may produce fatal results by a downward course, invading the trachea, bronchi, pleura (Fulzer), or upward to the meninges, to the cranial cavity, causing fatal meningitis (Von Stein). Phlegmon does not so extend, but produces death in an entirely different manner (Von Feinsten).

The prognosis in phlegmon is extremely grave. It is difficult to accept Kuttner's optimistic belief that many cases recover which are not reported because the observers doubt their diagnosis. Certain it is that the great majority of phlegmons of larynx or pharynx end in death; the few that have recovered have done so after protracted suffering and grave intoxication.

The writer takes this opportunity of putting on record a typical case of primary laryngeal phlegmon, which he observed at Michael Reese Hospital in 1904.

Early in the morning of February 13th, I was called by Dr. Greensfelder to see Miss L., surgical nurse in charge of the operating room at Michael Reese Hospital. She had complained on the previous morning of a slight soreness in the throat on swallowing. The pharynx had been examined and, finding nothing visibly wrong, a simple gargle had been ordered, and the matter dismissed as unimportant. I wish to make this phase of the disease marked in order to impress the insidiousness with which this fatal disease may begin. About sixteen hours after her first complaint, I found a well-nourished woman, past forty, propped up by pillows in bed to a semirecumbent position. The expression of her face was not anxious but quite calm, except when she swallowed, when a grimace of pain spread over it. She expectorated the superabundant saliva rather than suffer the dysphagia. The voice was slightly clouded but not hoarse. The sensorium was not normal. The change in this regard might have escaped the observation of one not so well acquainted with the practical, matter-of-fact woman as ourselves. There was a certain nonchalance, a forced smiling, a casting of the eyes downward at the bedclothes, which she folded and picked. The temperature was 104, pulse 114, respiration 32. She complained of headache, pain in the throat, especially marked on the right side and made lancinating by deglutition. Examination of the pharynx disclosed nothing but a chronic bilateral pharyngitis. She opened her mouth readily and freely.

Laryngoscopy.—The base of the tongue (lingual tonsils) was quite normal. On the right side of the epiglottis, beginning at the tip and extending along the edge to the aryepiglottic fold, was an infiltration of a dirty pinkish-gray color. The right false vocal band was very slightly swollen, but not markedly hyperemic. The mucosa of the entire larynx gave one the impression of grayish lividity, of being lustreless and minutely roughened; little flakes and streaks of muco-pus lay here and there. The vocal bands were silghtly hyperemic but not swollen. In fact, there was but little swelling anywhere; that on the epiglottis was very slightly elevated and disappeared imperceptibly into the surrounding tissue.

Later in the day the temperature dropped two degrees. Delirium and dysphagia increased. The infiltrations spread to the left side of the epiglottis, down the aryepiglottic fold to the vestibulum during the next twenty-four hours; then via the pharyngoepiglottic fold to the sinus pyriformis on either side. The view of the vocal cords was entirely cut off on the 17th of February, but symptoms of obstruction did not become marked until a few hours before death, which occurred at 11:05 A. M. on February 17th, so obviously from general sepsis and heart failure (pulmonary edema) that tracheotomy was deemed superfluous at a consultation of the attending surgeons of the hospital.

On February 16th the gland over the cricothyroid ligament became swollen. This corresponds with the extension of the process below the vocal cords, and tends to corroborate Poirier's (*Bull. Soc. Anat.*, 1887) researches on the region drained by these nodes.

The temperature ranged from 103 to 104, but with slight intermissions, when it fell once to 101. The pulse ranged from 100 to 140.

The delirium gradually passed into lethargy and this into complete unconsciousness long before the dyspnea became apparent. The urine was loaded with urates, but that passed during the first two days contained no sugar or albumin. Leucocyte count 24,000 on the second day. Cultures taken from the interior of the larynx at various times gave streptococcus in almost pure culture, whose morphologic and cultural characteristics correspond with those of streptococcus pyogenes aureus.

An autopsy was not permitted.

Treatment.—Those who come in contact with the sick, and especially those who are much about pus cases, should habitually use a prophylactic mouth wash and gargle. This applies peculiarly to nurses and internes, whose devotion to duty is too often accompanied by insufficient out-door exercise and fresh air, and renders them especially liable to throat infections. For this purpose I have been recommending for some years past the following formula:

R Acidi salicylici	dr. iv
Spts. ætheris nitrosi	
Alcohol	aa oz. i
Formalin	(1-10) oz. ss to oz. i
Ol. caryophil	dr. i
Glycerine	q. s. oz. iv

A half teaspoonful of this to a half glass of hot water is used as a gargle and mouth wash whenever necessary.

The treatment of either erysipelas or phlegmon by injection of antistreptococcus serum has been followed by results that, to say the least, are disappointing. Our case of laryngeal phlegmon received two injections, one twenty-four hours from beginning of the disease, and one twenty-four hours later, without in the slightest degree changing the local or general conditions one way or the other.

Our treatment must therefore be symptomatic; thus we have three principal indications: First, to combat the dyspnea; second, to keep up strength and combat heart failure; third, to assuage the dysphagia. In erysipelas the first indication is most imperative; in phlegmon the second. Therefore, in erysipelas we may be compelled to resort to tracheotomy or intubation very early in the course of the disease. It should never be put off, but when the laryngoscope discloses a dangerous swelling, operative efforts to maintain respiration should be decisively made. In the majority of cases of phlegmon death occurred before dangerous dyspnea developed. Blebs of the mucous membrane should be opened if they are situated in a position to interfere with respiration; otherwise, they are unimportant and may be let alone. Whenever pus is demonstrated, efforts should be made to liberate it at the earliest possible moment. Hot and cold applications to the neck have been recommended. Massei is especially enthusiastic in the employment of cold. According to Paralowsjy's experiments, the employment of such cold applications tends to delay or arrest the multiplication and development of streptococci. It may be used externally in an ice bag, and small ice pills may be dissolved in the mouth. Bryson Delevan employed a spray of zinc chlorid and an alkaline solution of quinin, together with steam inhalations of antiseptics. Massei employs swabbing the throat with 1-2000 corrosive sublimate solution.

In our case adrenalin solution with and without cocain was employed with very slight effect on the distressing local sensations. The strength was kept up by rectal alimentation, the use of coffee and brandy and continuous rectal normal salt injections, and the hypodermic use of cardiac stimulants. Oxygen was employed toward the end when the first symptoms of dyspnea developed.

But in spite of all the patient died five days from the time she first complained of pain in the throat.

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LXXVIII.

AN ORIGINAL RESEARCH ON THE CAUSE OF VOCAL NODULES.

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NEW YORK.

I desire to call attention to an entirely new theory of the formation of vocal nodules, based upon the personal observation of 234 cases occurring in my private practice. The facts herein mentioned are the results of further patient and persistent investigation of this subject, especially in consequence of many letters received from physicians and voice specialists, who have read my article on the same subject in the November, 1903, number of the *Laryngoscope*, and have requested further explanation of the cause of vocal nodules. With this object in view, I have had five original and very careful dissections or larynges made by Dr. Edgar E. Stewart and Mr. and Mrs. H. Howard Brown, voice anatomists of large experience, to whose skillful work under my direction this discovery is mainly due.

Summary. Of 234 cases of vocal nodules coming under my observation during the last fifteen years, 136 were found upon the left cord, 98 were on the right vocal cord. 32 were bilateral and symmetrical vocal nodules, that is to say, on the left side and right side at "C" sharp, that is at the anterior third of the cord, the most common place for nodules, two single nodules and two bilateral and symmetrical at "F" sharp in company with double bilateral "C" sharp nodules. The "F" sharp nodules were situated about half way between the thyroid end and the anterior third of the cord: One at "G" sharp, the remainder at "C" sharp. There was one "B" flat nodule on the left vocal cord and this was in company with a bilateral symmetrical "C" sharp nodule. This makes it very evident that these nodules occur at as many as four different points on the vocal cords, although the records of some investigators of this subject seem to allow for one only, and that always occurring at about the same point.

Before stating my theory of the origin of these nodules, I shall give the results of different kinds of treatment employed by me for their eradication. Prior to the year of 1902, I employed the ordinary medical means familiar to all. I found that such treatment was attendant with more or less indifferent success. Having been a public singer of recognized standing for a number of years, the pursuit of this subject was of especial interest to me. and while recognizing the fact that all nodules known upon the vocal cords did not occur in singers' throats, the systematic recurrence of nodules at specific points on the vocal cords. long ago led me to believe that the manner of voice use had something to do with this phenomenon.

During the year 1902 I met Mr. and Mrs. H. Howard Brown, the voice specialists whom I have already mentioned. They demonstrated to me a theory of voice action and a system of training which seemed to me to have a definiteness not present in the empirical system with which I have been familiar before. They assured me that in such cases of singers' nodules and vocal paralysis as I might have among my patients, there would be present certain vocal derangements, which, when removed, would better these conditions. Experimenting upon this, I sent them a number of people and the rapidity and certainty with which nodules and paralytic conditions disappeared were to me remarkable.

I herewith state the result of a few cases which were cured in this way.

Miss L. J. T., soprano with all the natural attributes for a magnificent singer: Voice out of commission. Double nodules cured in fourteen lessons. Reports made to me showed chin muscles much over-contracted, tongue badly depressed and tone consequently pinched. Remained with these teachers for some time and is now doing concert work. occupying position as dramatic soprano soloist in Temple Emanuel. one of the largest congregations in New York.

Miss E. P., soprano. Double nodules, tongue depressed, jaw pulled out of place, tone pinched, cured in thirteen lessons. Remained for one year, now in Berlin studying for grand opera with G. B. Lamperti.

Mrs. M. D., sporano in grand opera. Chin muscles over-contracted, voice pinched in high tones. nodule began to disappear in two lessons. Took ten lessons in all and returned to opera singing. Assured us two years after that she had had no further trouble.

Miss G. R., principal soprano in Savage Grand Opera Co. Chin muscles over-contracted and tongue depressed, voice forced in high tones. Nodule on cord for four months, break in voice at "F" sharp. Nine lessons, without interfering with daily rehearsal; during the last part she sang four roles in one week. Voice then perfectly clear. The nodule was cured after the seventh lesson.

Mrs. J. T. O., soprano. Chin muscles over-contracted, voice totally paralyzed for singing effort. Fifteen lessons, sang concert in Providence, R. I., receiving good press notices.

Mr. E. W., noted concert tenor. Interarytenoid swelling for three years, tone husky, palate relaxed. Forty-seven lessons, great success in England. After a recent concert in Nashville, Tenn., paper styled him "The greatest tenor, by far, who has ever sung in Tennessee." Laryngeal condition perfect and tones perfectly clear.

In all of the above cases, in addition to vocal means, they used some Swedish massage movements on contracted chin muscles, believing that much good was accomplished by this means during the first stages of treatment. These movements aid in cure by relieving some of the worst muscular contraction and by stimulating circulation and nerve supply.

The general result of treatment of all these cases corresponds with the instances quoted above.

In the year 1903 I purchased an apparatus which, as used by me, has proven the sovereign remedy for nodes. This instrument completely supersedes the mechanical work above mentioned, and has more value in that it is an anesthetic and produces powerful desensitizing effects upon the mucous membranes, that border upon the marvelous. We know that a powerful blow behind the ear, upon the chest, back of the ear, or in the epigastrium, namely, over the principal vaso-motor ganglia, will shock the subject to which the blow is given, causing an anesthesia of that part, and a blanching of the mucous membrane within the nose and mouth similar to that produced by a sudden most serious hemorrhage. With an instrument which consists of a rubber cap screwed into a Swedish massage bulb fastened to a Vosberg's cable and a rapid motor operating this cable, anywhere from 1800 to 3000 revolutions can be administered to the human body in the shape of blows accompanied by oscillation and suction.

By placing this instrument at a speed of 3000 revolutions per minute back of the ear and drawing it in the position of the stylo-pharyngeus from its mastoid attachment to the thyroid, then over the sterno-hyoid and sterno-thyroid, thence over the four layers of chin muscles, thence over the angles of the neck, then again from the occiput down along the spine along the vertical column to the os sacrum (the whole process not taking over two minutes), there will have been produced in the mucous membrane of the nose and throat most remarkable phenomena. A pallor will have spread all through the nares, posterior and interior, over the pharynx and into the larynx and particularly will mark the region of the epiglottis and larynx. Vocal cords with nodes upon them which are red and bulging and covered with mucus, will seem to be several shades paler. The cords themselves will be less bowed and the node will become surprisingly smaller and apparently absorbed to a great degree.

I know of no means that produces such quick and remarkable effects upon the mucous membranes of the vocal cords or upon these various parts mentioned above; so remarkable is this, that nodes, if quite acute, not too large and deeply infiltrated, will be absorbed in from three to five days. Of course, by singing again they are apt to recur, especially if the false mechanism is indulged in, or the reflex conditions established by the node-producing element have not been eradicated.

Observation, therefore, and recent experiments, lead me to believe that if these nodules of singers are to be permanently cured, the means of a correct vocal action must be resorted to in the majority of cases. Many people, not singers, produce nodes by coughing. I have seen a dog with nodes. But the nodes of singers which have caused so much discussion have been referred to by Prof. Turck, who first illustrated and called the attention of the profession to chorditis tuberosa acuta. Dr. Jas. P. MacAvoy, of this city, in his reminiscences of Prof. Schnitzler, of Vienna, says that he was accustomed to say to his post-graduate class of students from all parts of the world, "A guinea to the one that makes a correct diagnosis!" Although Dr. MacAvoy lived with Bergasse, Prof. Schnitzler's first assistant, for three years, he never saw the guinea carried away; he never saw a student able to make the diagnosis of a singer's nodule or the acute chorditis of singers. It is no wonder then, that its diagnosis and etiology have been questioned.

The purpose of this article is to throw any additional light possible upon work which has already been done, and if issue is taken with any statements made by other voice specialists, it is for the purpose of furthering investigation by causing discussion of any points at issue, and in order that eventually we may arrive at the truth. That there must be cogent reasons for the affinity of the vocal nodule for certain portions of the cords, is certainly recognized by the most competent laryngologists, who have advanced many theories as to their cause, most of them mysteriously seductive, but not any of them definite enough to satisfy careful analysis.

In explaining this latest theory, it is necessary to understand something of voice action, and before stating my theory, and before giving the result of a microscopic examination of double nodes, which I removed from vocal cords, I will give a brief explanation of what I believe to be the correct standard for tone production. The fundamental movement consists of breath pressure. This production is caused by two movements, inspiratory and expiratory: The inspiratory movement consisting of exertion of the rib raising and expanding muscles, and contraction of the diaphragm. The expiratory movement consists of contraction of the abdominal and back muscles, which pull the ribs inward and downward. It is unnecessary for me to go into details any further than to say that it requires skillful work to establish a balance between the exertion of the expiratory movement, and the letting go of the inspiratory effort. The index of this breath control and pressure can be felt below the base of the breast bone, where it seems as though on contraction the rectus abdominis muscle bunches itself, giving apparently a forward movement. It has been known for a long time that in singing the scale of pitches, the thyroid cartilage tilts forward and the vocal cords are lengthened. We will designate this action as "cord stretching" for the purpose of lengthening and thinning the vocal cords as the scale ascends. This tilting is accomplished by means of the palato-pharyngei muscles which fasten to the upper back border of the thyroid cartilage, and on contraction pull towards their fixed end on the hard palate.

Attaching to the under side of the hyoid bone and on contraction pulling towards their fixed end at the top of the breast bone, we have the sterno-hyoid muscles. The first of these pulls somewhat upward and forward at the back of the larynx, and the second pulls downward on the front of the larynx, causing a forward tilting of the thyroid cartilage. The vocal cords are fastened in the angle of the thyroid cartilage at their anterior ends and at their posterior ends to the arytenoid cartilage. It must be remembered that the arytenoid cartilages are attached to the cricoid cartilage, and do not move excepting to approximate the cords. In order that the larynx may have a fixed point upon which this tilting can take place, it is provided that the stylo-pharyngei muscles, fastening on the upper back edge of the thyroid cartilage and upon contraction pulling towards their fixed end at the styloid process, and the sterno-thyroid pulling from the side of the thyroid cartilage to the breast bone, combine to hold the larynx in place. I have watched the results of vocal work based upon this action, and have found them thoroughly satisfactory.

I herewith give microscopic examination of double nodes. The epithelial layer manifests no deviation from the normal, either in its external hornified stratum (which is very thin) or in its relation to the subepithelial connective tissue, in any portion of the sections examined. Except in one or two very small segments, the thickness is almost uniform throughout. Even with strong magnification (x460), not the slightest evidence of separation from the subepithelial layer can be noted. At a point corresponding to the apex of the nodule, there is a flask-shaped invagination, or crypt-like depression, about one-fifth the size of the total mass. This invagination begins as a tubular inversion which gradually enlarges to bulbous shape in the depth. In some of the sections this sacculation appears as an almost spherical closed cavity, which phenomenon, no doubt, is due to section above or below the level of the outlet to the epithelial surface. It could not be determined whether or not this was an artifact due to shrinkage in hardening of the tissue.

The connective tissue composing the bulk of the nodule is densest immediately beneath the epithelial layer, and gradually becomes more and more rarified as the base or attachment to the cord is approached. Throughout these portions the spaces formed by separation of the connective tissue fibres are infiltrated with a greater or less amount of homogeneous or very finely granular translucent substances, in every way resembling coagulated edematous (serous) fluid. Near the base or cord attachment, the tissues are so loosely arranged that the fibrous fibrillae form a fine reticulum, the spaces of which are infiltrated with the translucent, homogeneous or firmly granular material. Here the tissue cells have assumed a marked stellate shape with decided prolongations, which anastomose with fibrillae from other cells of like nature to form this reticulum. This appearance is unquestionably due to edematous infiltration of a passive and very probably a chronic nature, since there is nowhere any evidence of cellular proliferation, except in the intima of the smallest vessels, which show a moderate degree of nuclear activity, but not sufficient to markedly encroach upon the lumina. No red blood corpuscles and but rarely a polynucleated leucocyte (wandering cell) were noted outside of the blood vessels.

Except for a slightly thicker horny layer of the epithelial covering, the nodule lowermost upon the pin presents the same histologic features.

Conclusions drawn from careful microscopic examinations made by Drs. Henry T. Brooks of the Post-Graduate School of Medicine, and John Larkin of the College of Physicians and Surgeons of New York, made especially for this article, show that in its simplest form the nodule is a superficial edema, manifesting itself on the edge of the vocal cord, sometimes appearing on one and then on the other, and at times on both, making symmetrical and bilateral nodules, dependent entirely on causation. For instance, the cause might be a simple case of coughing, and to simplify matters pathologically the nodule is an edema, a swelling from effusion of watery fluid in the cellular tissues beneath. If aggravated by continued use of the voice, it may develop and become exceedingly dangerous to the voice by extending outward to the tissues of the cord itself. The cure for this state of thing is by absorption of the fluid contents and a consequent diminution of the size of the nodule, until finally the condition of the cord becomes normal and the voice is fully restored. In the formation of the nodule, it is worth remarking that the traumatic or coughing nodule may appear at any point of the cord. It shows at first at one point and then at another. The nodule caused by vocal weakness, however, displays an exasperating, even puzzling affinity for particular portions of the vocal cords. It is generally found protruding from the anterior and middle third on one or the other side of the glottic opening. In fact, it frequently happens that the traumatic nodule and what for convenience's sake has been arbitrarily styled the "vocal node," are simultaneously present, the traumatic nodule existing by itself in some irregular portion of the cord or superimposed upon, or blended with the vocal node, each to be distinguished by its well defined location, although produced by totally different causes.

Those who would explain this by the theory of attrition or segmentation, would refer you to the stroboscope of Oertel, or possibly to the more or less familiar trick of the vibrating string and the bit of paper. If the paper be laid upon the string at a certain point it will be flirted away, while if it be laid upon the string at another point, the rest point, if you please, it will slip unagitated to the floor. Inasmuch as the vocal cords are subject to the same laws, the lesson drawn from the string and the bit of paper applies, the nodule taking the place of the paper. Note, however, the difference. The string is single and there is no attrition. If there were two strings, the bit of paper might be caught and sadily twisted in a miniature whirlwind of opposing vibrations, and a node produced symmetrically on its mate, the opposite cord.

By studying the laws of vibration of strings and pipes in physics, we find that there are sections of the vibrating string and portions of the air in the organ pipes which do not vibrate with the string or pipe as a whole, but which, as nodes and segments, subdivide the string and pipe into active and passive portions.

By careful observation we are able to see whether the vocal cords are making a segment in the center or whether they are vibrating longitudinally without making a segment with the opposite one by vibration. Dr. Curtis says: "As a matter of fact, the tiny pearls of mucus are driven by the centrifugal force of the vibrating vocal cords to the middle point of the vibrating segment and from thence are thrown outward. They mark, then, if anything, points of greatest movement in the vibrating segment, and not points of rest." Again, "This observation confirms the theory advanced several years ago by me as to the formation of nodules of attrition in singers' cords, and explains the removal of the same by exercises of vocalization."

There are those who define a "singer's nodule" as an inflammatory growth situated at the junction of the anterior and middle thirds of the vocal cords, a definition which is certainly most unsatisfactory when we know for a fact that nodes occur between the middle of the anterior third and at the posterior third, and also on both cords as well as at the junction of the anterior and middle thirds. It has also been said that these growths are due to the employment of an injurious method of attacking tones, and are to be eliminated by using a "focus" of tone a (a term certainly very hard to understand). This "focus" of tone places the initial impulse upon the cords in such a manner that attrition becomes impossible. I take issue with this statement because I believe that attrition is not necessary to form the nodule, as will be seen when I state my theory. It may be after these growths have been started they may be enlarged by attrition.

The defenders of the segmentation theory (portions of the vocal cord being divided into parts), state that the damage to the singing voice occurs in the upper medium register. What is meant by this is probably the upper half of the middle register, relatively high or low according to the voice, whether it be soprano, contralto, tenor or bass. It is also said that this segmentation is rearranged for higher pitches in such a manner that the vocal cords do not rub against one another. On the theory of the specific action of the thyro-arytenoideus externus muscle that I now propose, this rather mysterious statement is unnecessary. I also take issue with the following statement: "That singers' nodules are the result of a direct mechanical effect caused by the interference of opposite vibrating segments, and are not true nodes in an acoustic sense has been proven beyond doubt by the investigation with the stroboscope of Oertel, Koschlakoff and Simanowski." Of course we all have our own opinion, and having made some investigation, we think that this is not proven beyond a doubt, and we do not believe that it can be so for the one grand reason that it is impossible to make proper observation with an instrument which employs a human subject whose cords are to be seen; again the eye and hand of the operator, and still further an instrument whose revolutions are too rapid for the human eye to make correct observation; and then again in all of these observations we can see only the one side of the cord, that being the upper side.

My theory on the causation of singers' nodes is as follows: A great majority of the subjects present a follicular tonsillitis. Accompanying this there is more or less congestion of the mucous membrane in the larynx. This renders that portion over the vocal cords more liable to become edematous. It is further thought that there is a hyperactivity of certain fasciculi of the thyroarytenoideus externus muscle, and that where these bundles cross the true cords there is produced a localized edema or singer's node.

By a remarkable combination of circumstances, it has been my privilege to have under my professional care all four of the leading solo soprano voices of Old Trinity, St. George's Church, Heavenly Rest and St. Thomas'. These boys have all begun their changes in voice under identically the same conditions. The boys I refer to are Earl Gulick, Allen Schnebbe, Charles Mehan and Maxwell Kennedy, well-known boy sopranos, who have sung all over the country. The observation consisted of this: First, that it was the inflammation of the left tonsil, then a partial paralysis of the left cord, then the production of a node on the same cord at "C" sharp, followed by the production of another node upon the other cord. In the left tonsil of each one of these cases were found chronic follicular tonsillitis as determined by the usual signs of this disease, one of which was the ability of the affected tonsil to express large cheesy plugs. In all these cases, beyond a slight inflammation of the anterior and posterior pillars, there seemed to be nothing else to be observed about the tonsil. All of these little patients did not come to me for sore throat, or because they were afflicted with tonsillitis, but to consult me on their vocal debility and the loss of their singing voice.

One of them in particular went away with diagnosis of cheesy deposits in the left tonsil and partial paralysis of the right cord, with my request that he should not sing owing to an impending change in his voice. I did not treat this boy at all, did not even spray his throat because I saw the nature of his voice failure. I merely expressed a few of the cheesy deposits out of the tonsil crypts with the result that at that service he sang well. He returned to me, however, with a node in his vocal cord produced in his attempt to sing "A" at this service. Going from the medium "E" to the high "A" he felt a sudden giving away of his voice, although he was able to hold the note almost to its end. The following Sunday he was unable to sing, and although the boy returned to me during the week, I did no more to his voice than to tell him that I thought the change had begun. On the next Sunday his voice failed completely, so much so that the very remarkable statement was made by one of his musical friends to the effect that, while the first spraying of his throat had resulted in a decided relief from all his vocal debility and had put it in good order, the second spraying had brought about a condition that had ruined his voice. Subsequently, at his father's suggestion, the boy resigned his position. In reality I had not used the spray at all, and did not treat him the second time. Since that time he has not sung at all, his voice having descended an octave without treatment, except for the treatment of the ear on the same side with the inflamed tonsil, and which has been affected a long time in consequence of the diseased tonsils through the auricular branch of the vidian. Undoubtedly, this had also affected the nerve supply of the ear and had created certain catarrhal disturbances affecting that ear seriously. As a result his voice has completely changed and is now in that broken condition that usually follows the change of boys' voices always noted at puberty. The node, however, has entirely disappeared and so has the paralysis of the cord, while in singing the usual phenomenon takes place, although he is now 14 years of age. Should he sing from "A" flat down to "C", his voice would immediately break at "C" sharp and jump a fifth, that is, to the "G" sharp below, either going into the man's voice or giving out entirely. Now in singing his voice jumps the entire octave from "C" sharp down to the lower "C" sharp on almost every occasion, and, strange as it may seem, all of these boys have had exactly the same phenomena.

If we turn to the thyroarytenoideus externus muscle, we will see that its action is somewhat complicated on account of its attachments.

A brief description of the anatomic conditions existing in this portion of the human larynx would seem appropriate here. The thyroarytenoideus internus extends horizontally backwards from the inner surface of the thyroid cartilage in front, near the median line, to the muscular process of the arytenoid cartilage behind on either side, and forms the inferior or true vocal cords. Externally or laterally, but still within the confines of the thyroid cartilage, this muscle is overlapped by the thyroarytenoideus externus or wall muscle, whose fibres run almost vertically upward from the anterior inferior part of the inner surface of each ala of the thyroid cartilage, from its lower border in front, and also from the anterolateral portion of the inner aspect of the cricothyroid membrane to spread out in the mucous membrane of the larynx above, and is inserted in part into the edge of the epiglottis. Thus it will be seen that these muscles cross nearly at right angles, somewhat in the manner represented in the diagram. It is just at the site of contact of these two muscles on the mucous membrane where the vocal nodes occur. From Luschka's drawing, it will be seen that there are practically three divisions of this muscle: the arytenoid division which unites with the cricoid, the thyroid division, and the epiglottic division. The action of this muscle plays a most important part in the approximation of the vocal cords, and as normal intrinsic action is dependent upon normal extrinsic action, it will readily be seen that any derangement of the external action would cause a direct tendency of this thyroarytenoideus externus muscle to overact, and it is upon the combination of those tonsillar lesions and the overaction of this muscle that my theory is based.

With regard to prevention of nodes, if in childhood adenoids and tonsils receive their proper attention, if lingual tonsils and pharyngeal hypertrophies are watched with care and removed; if children are made to be very careful during the period of voice change, menstrual functions and other conditions which cause sympathetic nervous changes to take place affecting the mucous membranes at the age of puberty; if a correct synthetic voice production or voice science be established, which can be simplified and studied by proper anatomic and physiologic laws, we probably would never have the nodule question to consider except as a matter of accident.

Acting upon this theory, I have caused some dissections to be made with the inference that there must be some factor at work beneath the mucous membrane over the cords which cause a local edema and consequently the slight elevations which appear. The idea was conceived that the venous return might be cut off by the pressure of certain muscles acting in different directions and thus cause the local swelling.

Case I. Larynx of a Chinaman, aged about 45. Occupation, laundryman. Voice high pitched, larynx large. Found thyroid fasciculus large; cricothyroid fasciculus also large, but a space between these fasciculi where the muscle was very thin. Arytenoid fasciculus broad and thin. There were no nodes on these cords. The larynx was a beautiful specimen, but the tonsils were in their normal condition.

Case II. Larynx of a negro, aged 24. Occupation, waiter. Voice gutteral, specimen large, cords lax. The anterior fasciculus was larger, broader and stronger than in the former specimen, but the cricothyroid bundle was not as distinct. The space between these fasciculi was better filled with muscular tissue. No nodes existed. Tonsils normal.

Case III. Larynx of a white girl, aged 18. Occupation, unknown. Character of voice not known. Larynx, fair size. Thyroarytenoideus externus well developed, especially its posterior portions, that is, those arising from the cricothyroid membrane and from arytenoid. No nodes present. Tonsils normal.

Case IV. Larynx of a butcher, aged 45. Specimen of medium size. Character of voice not known. In this instance the thyroarytenoideus externus was more peculiarly sloped, the lower part extending mostly from the thyroid cartilage. Was quite thick and broad for about one-half its course. The upper end, while not entirely lacking, was very poorly developed. For this muscle, there was no fasciculus more distinct than another. Pharyngeal tonsils normal. No nodes present.

Case V. Larynx of a laboring man, aged 40. Specimen of large size. Character of voice unknown. This larynx resembled the previous one in all particulars, except that the upper fibres of the thyroarytenoideus externus were more distinct.

Case VI. Male larynx, aged about 35-40. History unknown. Very large. Thyroarytenoideus well developed, especially the arytenoid fasciculus. The muscle was unusually thick where it overlapped the cord. No nodes were present. Tonsils not enlarged.

After procuring these photographs of this muscle, I recently had the following experiments made to try to produce a node:

A medium-sized dog was examined to see if he had any nodes on the vocal cords. None were found. His larynx was then operated on, using the modern surgical asepsis with the idea of producing nodes. The anterior inferior angle of one ala of the thyroid was trephined (3-8 inch trephine) and a mattress suture taken in the thyroid fasciculus of the wall muscle. The parts were then closed. The dog was allowed to live two weeks, means being taken to cause him to bark considerably during this time. He was then chloformed, the larynx taken out and the following observations made: Skin wound healed by first intention; parts beneath in beautiful condition; muscle shortened considerably. No nodes were found.

This would hardly disprove the theory, as the tonsils were not in the typical condition observed by me.

Another experiment: A fairly good sized shepherd dog was used. In order to produce a tonsillar inflammation in the animal, a plug of debris was expressed from tonsils of two renowned singers having nodes, one male, the other female, and rubbed with considerable pressure into the mucous membrane between the pillars of the fauces while the dog was anesthetized. This was done within eight hours after removal from singers' throats. On inspecting the throat every day for a week, no change was noticed.

Several factors were supposed to account for this. First, the bacteria contained in the tonsillar plug from the human pharynx were thought to be of too low a virulence. Second, the resistance of the mucous membrane without any previous congestion was thought to be too high. Third, several errors in technic were discovered which probably played a lesser part.

These several indications were met in the following ways:

The resistance of the tonsils and mucous membrane was lowered by painting the region with cantharidal collodion while the dog was anesthetized. This produced a typical congestion and in a couple of days a young and virulent culture of pure streptococci was rubbed on the inflamed parts. No false membrane formed but a true tonsillitis developed. After a few days the dog was prepared for operation (neck shaved and all aseptic precautions taken). The skin incised in the median line, one ala of the left thyroid cartilage exposed. This was treated in the following manner: A slit-like opening was made in its lower part about 3-16 of an inch in width and almost as long as the entire width of one ala. The piece of cartilage was removed and the thyroarytenoideus externus lifted into the gap. From its central portion a piece was removed consisting of the entire thickness but not completely dividing the muscle, leaving the anterior and posterior portions in the hope that nodes would be produced at the joints where these fasciculi pressed on the true cord. The vacancy in the cartilage was then packed with a gauze drain and the latter carried to the surface. The skin was sutured and a dressing 1-100 formalin was used. Convalescence was uneventful, except that it was noticed that the dog's bark had changed.

The cords were examined with a laryngoscope and a node was noticed about where the posterior fasciculus crossed the cord. The dog was shortly afterwards chloroformed and the larynx and tongue were removed. A node was observed on the posterior portion of the left cord. The larynx was then placed in a weak solution of formalin and the node became smaller. On splitting the larynx open from behind through the cricoid cartilage, the node disappeared. From this it is suggested that nodes cannot be preserved after death.

We have under way several experiments of like nature, by which we hope to prove that nodes can be produced in every case by means of infection of the tonsils and perverting the action on the thyroarytenoideus externus muscle. We hope to have the pleasure of demonstrating the successful outcome of these experiments at some future date.

In closing the discussion of this article, I desire to give credit to all of our professional brethren who have done valuable service in the treatment of singers' nodules.

We admit that our system is not the only method of cure, but we claim that if this system is followed, it will be further reaching than temporary cures, that if given a reasonable length of time, it will tend towards a great lessening of this evil with a possibility of its eradication.

By combining our efforts we, the throat specialists of the world, might become largely instrumental in helping singers and singing teachers to cast aside forever empirical methods, and accomplish the development of the only true thing, a synthetic method. Although the main purpose of this article seems to be the establishment of the origin of nodes, I should feel highly gratified if the ultimate outcome of it should be their prevention.

I, therefore, close this article and its discussion by laying especial emphasis upon the clause relating to prevention. I extend sincere thanks to those who have aided me in the preparation of this article, and to all the gentlemen here present for their courteous attention during the delivery of it.

LXXIX.

CARCINOMA OF THE LARYNX—OPERATION AND SPECIMEN.

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On the sixteenth of January, a gentleman, 72 years of age, was brought to me for examination. He had been continuously hoarse for a period of six months. Previous to this hoarseness, there were six months in which the voice had been altered from time to time. The voice was raw, presenting the voice characteristics of a tuberculosis. The patient's general history was most excellent.

Present status: Apparently a strong, healthy man, of medium height, well nourished, slight pallor of the skin, nervous and excitable. Examination of the neck externally showed no enlarged glands; nose and pharynx normal. Examination of the larynx showed a growth involving and affecting the anterior two-thirds of the left vocal cord, and extending slightly and apparently beyond the commissure to the other side. It was interesting to note that this patient never complained of spontaneous pain or any painful sensations after talking. Diagnosis was made of cancer of the larynx and the patient so informed. Procedure to be adopted was left open to the patient, he being told of the various methods of treatment. After about three days he decided that he would have the growth removed, and all arrangements were made to do a partial or complete laryngectomy, according as the condition required. On February 4th the operation, which necessitated about two and one-half hours of actual time employed, was done. The patient was placed in the partial Trendelenberg position and no preliminary tracheotomy was done. A single excision, extending from the hyoid bone to within one-half inch of the sternum, was employed; no transverse cuts were made. Great care and precision were observed in the operation, all vessels being tied before being severed, and there was practically no hemorrhage. When the larynx was exposed, it was found to be almost completely calcified. The box of the larynx was split open and the growth examined. As the condition extended well over to the left side, it was thought best to do a complete laryngectomy and give the patient the opportunity of recovery, with the hope of no possible recurrence. The trachea was divided at the first ring, brought out of the opening and stitched to the skin. The larynx was then leisurely removed from its position. A good flap was obtained from above and the pharynx thoroughly closed off from the wound cavity. An iodoform wick was inserted in the wound and the lips of the wound brought together thoughout, except where the wick projected above and below. The wound was dressed as usual and the patient sent to his room. Reaction was good, temperature not going above 99° during the first twenty-four hours. The second day there was quite a sharp reaction, temperature running up to 102 2-5°; from that time it remained between 99° and 101°, until the termination of the illness. Respiration remained between 20 to 26 until the morning of the patient's death, when it ran up very rapidly. Pulse, lowest, was 77 and never reached above 128 until the morning of the patient's death. The condition of the wound was perfect throughout, only a little hemorrhagic oozing once or twice during the post-operation period. The patient was in good spirits throughout except the night before his death, when he became delirious, though not constantly so. On the fourth day food was taken freely, with no leakage in the wound, showing that there was complete closure of the pharynx from the wound cavity. The patient died on the morning of the fifth day in collapse. As no post-mortem was made, the condition which gave rise to the sudden termination can only be surmised; in all probability, it was cardiac exhaustion. There was very little secretion about the tracheal opening at any time during the operation. The dressing over the tracheal opening did not become very moist. The case seemed a most favorable one until the evening of the fourth day.

Remarks.—The most imporant question in these cases is, "Are they or are they not operable?" Although I was rather disinclined to do anything in this case, it seemed one of the most promising I had ever seen. The growth was localized, entirely intrinsic and extensive; there were no glandular infiltrations, and everything about the patient's neck seemed to promise a most successful issue in case the operation was made. He was anxious to be operated upon and anxious to get well. The operation was done with all due caution and careful technic; so, even in a case that might seem to offer every advantage from its character, the condition of the patient and the surrounding circumstances did not have a favorable outcome. To my mind it seems that complete laryngectomy does not offer a very favorable result in the aged. The violence is very great and it requires a strong, middle life to withstand the shock attendant upon such an operation. Of course, the question of a lesser operation enters into the plea also, for example, partial laryngectomy, done along the lines suggested by Sir Felix Semon, in which there is a partial excision, where there is a removal of the hard and soft parts of the larynx beyond the area of diseased tissues, and the operation which was narrated to me by Dr. J. Solis-Cohen, which consisted of stripping the perichondrium from the inner surface of the chondrium, thus removing the perichondrium, mucous membrane and growth en masse. To me it seems that this latter operation is one that offers great advantage, in case one could be assured that there was no involvement of the chondrium.

LXXX.

THE CLINICAL ANATOMY OF THE TONSIL.*

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The tonsil (Fig. 1) is situated in the sinus tonsillaris between the faucial pillars and has its origin in an invagination of the hypoblast at this point. Later the depression thus formed is subdivided into several compartments which become the permanent crypts of the tonsil. Lymphoid tissue is deposited around the crypts, and thus the tonsillar mass is built up. The inner or exposed surface, including the cryptic depressions, is covered with mucous membrane, while the outer or hidden surface is covered by a fibrous capsule.

It will be observed that the tonsil is an encapsulated organ, and that it is characterized by eight to twenty crypts or tubular depressions. Many practitioners have confused the tonsil with the follicular tissue immediately surrounding it. So long as they were able to remove follicular tissue through the wound in the sinus tonsillaris, they thought they were removing tonsillar tissue. In this they were mistaken, as the lymphoid tissue immediately surrounding the tonsil is not encapsulated, nor is it characterized by cryptic depressions.

The tonsil does not always completely fill the sinus tonsillaris, the unoccupied space above it being known as the supratonsillar fossa, into which several crypts usually open.

The outer aspect of the tonsil is loosely attached to the superior constrictor muscle of the pharynx, thus subjecting it to compression with every act of deglutition. The palatoglossus and palatopharyngeus muscles of the pillars also compress the tonsil. Grober cites authorities who claim that the compression of the muscles force food and bacteria into the crypts.

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*Candidate's Thesis for Fellowship in the American Laryngological Association, Niagara Falls, May, 1906.

The Crypts.—The crypts are usually tubular and almost invariably extend the entire depth of the tonsil to the capsule on its outer surface. Some, however, are compound, i. e., they divide below the surface into two or more tubules. They are usually comparatively straight, though they may be tortuous in their course. I have examined many tonsils removed with the capsule intact, and have rarely found crypts that did not extend through the follicular tissue to the capsule. Those opening in the supratonsillar fossa usually extend downward and outward, whereas in the lower portion of the tonsil their direction is outward. The area occupied by the mouths of the supratonsillar crypts constitutes, according to Killian, the hilus of the tonsil. Clinically, the crypts seem to be the source of the greatest amount of local and constitutional disturbances, as they often become filled with food, tissue debris and bacteria. This is especially true of those capped over by an overlying membrane, as in the supratonsillar space, and the anteroinferior portion of the tonsil which is covered by the plica triangularis. The plica supratonsillaris (Fig. 1) does not, in all cases, enfold the hilus, or supratonsillar crypts, as the tonsil often fails to fill the supratonsillar space. In other instances it closely hugs the upper end of the tonsil, thereby completely closing the mouths of the crypts. It is in these cases, particularly, that the contents of the crypts are retained. This is also true in reference to those covered by the plica triangularis.

Reasoning from a mechanical point of view, one would reach the conclusion that the retention of the infected secretions must necessarily give rise to infectious inflammatory processes. Clinically, we know that this is not true. The crypts are often found filled with food, tissue debris and pathogenic bacteria, without any appreciable inflammatory reaction. Nevertheless, as I shall exemplify later, the mechanical closure of the crypts by the plica supratonsillaris and the plica triangularis adds greatly to the tendency to inflammatory and other morbid local and general processes.

It may be stated as a general law in physiologic pathology that mechanical obstruction to the drainage of any secreting cavity tends to result in local morbid processes and in toxic or infectious manifestations in remote parts of the body.

The Epithelium.—The free surface of the tonsil, including the crypts, is covered with stratified pavement epithelium, the deeper layers of which are columnar in type, while the superficial are pavement. Goodale has shown that certain coloring matter when dusted in the crypts is readily absorbed into the interior of the tonsil. He claims that the absorption probably takes place through the interspaces between the cells. From this, the inference might be made that bacteria are absorbed with equal facility. This conclusion does not, however, coincide with either physiologic or clinical data.

Jonathan Wright has shown that there is a vast difference in the absorptive power of the tonsil for dust and for bacteria. He dusted in the crypts of the tonsil carmine powder and bacteria and excised it fifteen minutes later. The microscope showed the carmine particles in great abundance beneath the epithelium and within the intercellular spaces, whereas, no bacteria were found. He also observed that the carmine dust remaining on the outside of the tonsil was easily washed away, while the bacteria were more difficult to remove. The adherence of the bacteria to the live animal membrane and their failure to pass through it, he ascribed to the viscosity of the bacteria, a biomechanical property of microorganisms. The mechanical affinity existing between the bacteria and a living mucous membrane, he considered as one of their defensive and offensive properties of a biomechanical kind, as distinguished from their biochemical products, the toxin and endotoxin. Dust or carmine powder does not possess this adhesive property, hence it is readily absorbed, whereas the bacteria are not.

We know, however, from abundant clinical experience that there are conditions under which the bacteria are absorbed through the cryptic epithelium in sufficient numbers to excite marked local and constitutional disturbances. Apparently the adhesive property of the bacteria has been overcome, or the toxin of the microorganisms within the crypts has converted the live epithelium into inert matter, through which it readily passes. Wright again says "from the experiments of Goodale and others with colored granules, from my own observations of dust particles passing the epithelial layer in health, and bacteria passing it in diseases, it is evidence enough that there must be something beyond mechanical obstruction, which, under ordinary conditions of health, keeps the tissue beneath the epithelium free of bacterial life which swarms in some of the crypts on the outer side of the epithelial cells.

Hitherto the revelations of the antitoxic power of the blood sera have been insufficient to explain the problem. That explains the nullification of the toxic power of the pathogenic germ, after it passes within the tissues, but it does not explain immunity from infection—to translate literally, the freedom from the carrying in of the germ. It seems probable from experimentation with various forms of protoplasm that the animal organism evolves defensive properties to destroy by lysis, when the system through lack of excretory power becomes embarrassed by their presence."

Wright further says that "bacterial protoplasms may excite bacteriolytic ferments in the epithelial cells, a property heretofore referred by Metchnikoff to the leucocytes only." In these ways he attempts to show equilibrium existing between immunity and infection. An imbalance of this equilibrium is effected by a loss of local tonicity or health, and infection then takes place.

In the epithelial lining of the crypts we find, therefore, the following properties:

a. A biomechanical resistance to the invasion of the microorganisms, viscosity.

b. A biochemical destruction or taming of the microorganism in the crypts through the agency of a ferment thrown out by the epithelium under the stimulus of the retained bacteria. This process is known as bacteriolysis.

So long as the epithelium of the crypts is in a state of tonicity or health, an equilibrium between immunity and infection is maintained. When the cellular tonicity is impaired, the equilibrium between immunity and infection is lost and infection occurs. When the crypts are closed by the plica supratonsillaris and plica triangularis, or by concretions in the mouths of the crypts, a very active warfare between the retained microorganisms and the epithelial cells is begun. The cells throw out a poisonous ferment, whereas the bacteria throw off a toxin for the purpose of impairing the tonicity of the epithelium. If the siege is continued sufficiently long, the cells give way and the infectious host penetrates the epithelial barrier and enters the deeper tissues of the tonsil.

The Sinus Tonsillaris.—The anterior pillar contains the palatoglossus muscle and forms the anterior boundary, whereas the posterior pillar contains the palatopharygeus muscle, and forms the posterior boundary of the sinus. The pillars meet above to unite with the soft palate. Inferiorly they diverge and enter into the tissues at the base of the tongue and the lateral wall of the pharynx respectively. The outer wall of the sinus tonsillaris is composed of the superior constrictor muscle of the pharynx. The sinus tonsillaris is, therefore, a triangular depression on the lateral wall of the fauces which partially envelops the tonsil.

In so far as my clinical observations show, the tonsil is loosely attached to the sinus, that is, the so-called adhesions are not present. The extent of the attachment varies in different subjects. Patterson has shown that the supratonsillar fossa may extend downward so as to admit a bent probe between the outer side of the tonsil and the superior constrictor muscle of the pharynx, as far as the inner surface of the lower jaw. Even where the attachment is general it is not usually so firm as to greatly interfere with the enucleation of the tonsil. The "adhesion" to the anterior pillar so often spoken of, is, in my opinion, a myth. It is true that the tonsil has an anatomic connection with the anterior pillar, but the union is not of that firm fibrous nature usually implied by the term. Indeed, the "adhesion" often undoubtedly refers to the presence of the plica triangularis which covers the anteroinferior portion of the tonsil, and which is often attached to the tonsil at its inferior extremity. One writer even speaks of the plica triangularis as an hypertrophy of the anterior pillar, whereas in fact it is an embryologic structure, which in some of the lower animals develops into the tonsil itself.

The anterior limit of the sinus tonsillaris often extends well under the anterior pillar, thus concealing a large portion of the tonsil. The outline of the tonsil may readily be determined by digital examination or by seizing it with forceps and drawing it towards the median line of the throat. When thus drawn the anterior shoulder of the tonsil may be seen outlined beneath the anterior pillar, and if still more forcibly drawn inward, the tonsil mass slips from beneath the pillar, thus showing that it is not markedly adherent, but that, on the contrary, it is loosely attached and by proper procedure may be readily enucleated.

The Lymphatics.—The relation of the tonsil to the lymphatic vessels is somewhat different from that existing between the lymphatic gland and vessels. The difference in the relationship consists in the fact that the lymphatic vessels have their origin in the tonsil, whereas they pass through the lymphatic gland. The question of chief clinical importance is the course and termination of the tonsillar lymphatic vessels which drain into the deep cervical chain underneath the sternocleidomastoid muscle, and, from thence, to the thoracic glands and finally into the thoracic duct. By this route, infection is carried to all parts of the body. The tonsil, under certain conditions, being peculiarly susceptible to infection, becomes, therefore, the atrium of infection for a great variety of diseases extraneous to itself. The literature is rich with clinical reports of diseases illustrating this fact.

In reference to the tonsil as the portal of infection in tuberculous processes, it is pretty generally admitted that it often takes place through the tonsil and extends from thence through the lymphatics of the deep cervical chain on into the thorax. It then passes through the hilus of the lung into the visceral pulmonary lymphatics. The apex of the right lung is the most frequent seat for the inception of the pulmonary tuberculous disease. This has, heretofore, been attributed to the fact that this area is less directly in line with the respiratory air current, and that this portion of the lung has less motion than other portions of either lung. It forms, therefore, a peculiarly favorable location for the development of the tubercle bacillus.

Dr. J. Grober has called this route of pulmonary infection into question, or at least he has set up a rival hypothetical explanation, based upon a series of experiments upon lower animals. He reports the following three suggestive experiments out of a total of twenty-eight:

First experiment, September 16, 1902. A young rabbit was anesthetized by ether and chloroformed, and 1 ccm. of a sterilized emulsion of black Chinese paint injected into the left tonsil.

September 23, 1902, the autopsy showed black particles in the blood. Behind the left tonsil there was a mass compound of the coloring matter and leucocytes. The lymph glands on left side of the neck, as far as the upper border of the thyroid cartilage, were stained black. The microscope demonstrated the lymph vessels filled with free coloring matter, as well as leucocytes which enclosed small particles of pigment.

The glands and lymph vessels were fairly packed with the coloring matter. Beyond the zone of the lymph glands and vessels little coloring matter was found.

Second experiment. A small dog was narcotized by morphin injections. Six and one-half ccm. of the sterilized emulsion of black pigment was injected into the tonsil.

The autopsy, after complete exsanguination, showed the following conditions: very little coloring matter in the leucocytes, none being free in the blood. The tonsil and the loose connective tissue containing the afferent lymphatic vessels of the tonsil were of a deep black color.

Along the muscles of the neck, as far as the hyoid bone and to the median line, there were streaks of pigment. The pigmented area also spread downward below the hyoid bone, where it extended 1 cm. beyond the median line. The coloring matter was traced to the bony opening of the thorax and to the parietal pleura, which, when stripped off and examined by transmitted light, showed the black pigmentation. The lymph vessels of the paratracheal connective tissue, and of the esophagus as far as 2 or 3 ccm. above the bifurcation of the trachea, were also colored, whereas, on the left or uninjected side, no such phenomenon was found. All the lymph glands on the lateral wall of the pharynx, hyoid bone, larynx, along the deep vessels of the neck and supraclavicular fossa on the right side were black. The parietal pleura at the apex showed an exudate but no adhesion to the visceral pleura.

The microscope showed that in all the above mentioned positions there were no other changes present. In the glands the coloring matter occupied the paravascular spaces. In the lymph vessels between the supraclavicular glands and the parietal pleura of the apex, there were a large number of leucocytes filled with coloring matter. Free coloring matter was also present in this region. In the apex of the lung there were no signs of an inflammatory reaction. The coloring matter here seemed to be freely deposited within the connective tissue. In the above mentioned exudate at the apex, there was coloring matter in the leucocytes.

Third experiment, April 4, 1903. A small dog was placed under morphin narcosis and 5 ccm. of coloring matter injected into the tonsil. April 13th the same experiment was performed on the opposite side.

May 10th the autopsy, after exsanguination, showed a large amount of coloring matter free in the blood; the leucocytes, the tonsil and connective tissue, and the connective tissue of the neck on both sides along the larynx to the aperture of the thorax were colored symmetrically. The lymphatic glands along the large blood vessels as well as those in the supraclavicular region were deeply stained. The coloring matter was also found within the lymphatic vessels and in the paravascular spaces. A fibrous exudate was found in the apices of both lungs, thus forming a bridge of inflammatory material from the parietal to the visceral pleura. The coloring matter was also present in the exudate. The microscopic appearance of the apices presented a light greyish coloration. The glands in the mediastinum were stained on the left side, as were also the bronchial glands. In the left lung there were three other small fibrinous exudates in which the coloring matter was present.

From these experiments Grober builds the hypothesis that tubercular infection of the apex of the lung may take place via the deep lymphatic chain, the supraclavicular glands and thence to the parietal lymphatic vessels, where an inflammatory exudate is thrown across to the visceral pleura. The tubercle bacilli travel across this inflammatory bridge and enter the apex of the lung.

While these experiments are not conclusive they are interesting and open a field for further observations.

The Blood Supply.—The tonsillar artery, a branch of the facial, is the chief vessel to the tonsil, though the ascending palatine, another branch of the lingual, sometimes takes its place. The tonsillar artery passes upwards on the outer side of the superior constrictor muscle, through which it passes and gives off branches to the tonsil and soft palate. The palatine, another branch of the lingual, also sends branches through the superior constrictor muscle to the tonsil. The ascending pharyngeal also passes upwards outside of the superior constrictor, and when the ascending palatine artery is small, it gives off a tonsillar branch which is correspondingly larger. The dorsalis linguae, a branch of the lingual artery, ascends to the base of the tongue and sends branches to the nostril and pillars of the fauces. The ascending or posterior palatine artery, a branch of the interior maxillary, supplies the tonsil and soft palate from above, forming anastomoses with the ascending palatine. The small meningeal artery sends more branches to the tonsil though it is of minor importance.

Clinical Application.

Without reviewing the literature, which is rich in reports of cases showing the tonsil to be the portal of infection for many diseases in remote parts of the body, I have attempted to show under what conditions it becomes the portal or atrium of infection. Under conditions of local equilibrium or health of the epithelium lining the tonsillar crypts, infection does not take place, whereas, when the local equilibrium is lost, infection occurs. That the local equilibrium of the cryptic epithelium is frequently lost is apparent to every clinician. In addition to the diseases arising through the tonsil as a portal of infection, there are those limited to, or having their focal center in the tonsil itself. Perhaps the strongest indictment against the tonsil is that it is often the atrium of infection in pulmonary tuberculosis. Whether the route of infection is via the deep lymphatics and the hilus of the lung, or the deep lymphatics and the parietal pluera at the apex, as shown by analogy in the experiments of Grober, is immaterial in so far as the general question is concerned. The question of prime importance is, do pulmonary or other types of tuberculosis have their origin through the tonsil as a portal of infection? In view of my own observations, and of others, I must answer in the affirmative. Just what percentage, has not been fully determined. Various writers report from four to ten per cent of tonsils removed as showing local tubercular lesions, as tubercle bacilli and giant cells.

The structures of the tonsil which seem to favor infections are the deep crypts, especially those in the supratonsillar fossa and those covered by the plica triangularis. Wright has suggested that the imperfect drainage of the crypt leads to the ultimate loss of tonicity (equilibrium) in the epithelial cells lining them, thereby opening the way to systemic infection through the tonsil.

The question naturally presented at this juncture is, what is the rational method of procedure to protect the system from further infection. The choice of remedial measures seems to lie between internal medication, local applications, and surgical interference.

As to the first and second methods of treatment, it may be said that there are cases which may be satisfactorily treated by them, especially in relieving the distressing local inflammatory symptoms; indeed many cases may be practically cured by such treatment. There are many others, however, in which such measures are wholly inadequate, either to relieve immediate symptoms or to ward off future attacks. In these cases, we have usually resorted to some surgical procedure, such as opening the crypts, plunging the cautery point obliquely across them, decapitation (partial removal of the tonsil), and the complete removal of the tonsil.

The literature shows a wide divergence of opinion as to what constitutes the best method of surgical treatment, though it shows nearly all writers as being practically agreed that some sort of surgical procedure is indicated.

What does the anatomy seem to indicate? It shows certain crypts so situated as to afford poor drainage of their contents, even though the superior constrictor, palatoglossus and palatopharyngeus muscles compress the tonsil with each act of deglutition. This is especially true of those crypts discharging into the supratonsillar fossa. Killian has suggested that the supratonsillar crypts be opened with a sharp knife and that the incised surfaces be painted with 5 to 20 per cent trichloracetic acid. By this opening of the crypts their contents are drained. The acid applications excite a violent inflammatory reaction which results in the contraction of the tonsil tissue. The process is often an extremely painful one and may result in cellulitis and scar tissue. Furthermore, it does not always prevent further infection through the tonsil. It is, therefore, often necessary to repeat the incisions and acid applications.

The patient is entitled to immunity from tonsillar infection if it can be established without seriously jeopardizing either his health or life. When the tonsil becomes a well-established atrium of infection the physical economy of the patient is constantly menaced by conditions ranging all the way from a follicular tonsillitis to endocarditis and pulmonary tuberculosis: Measures should, therefore, be adopted which will ensure future freedom from infection through the tonsil.

It has been shown by abundant clinical experience, that cauterization of the lumen of the crypts or obliquely across them into the surrounding follicular tissue, does not adequately meet the indications.

The same is true of "decapitation" or partial removal of the tonsil. Decapitation leaves the deep and more diseased portion of the crypts, and while it may afford some relief of the symptoms, it is often followed by recurrent infections, and by the reformation of the tonsillar tissue.

The complete removal of the tonsil with its capsule intact is, as far as I know, the only mode of surgical procedure that guarantees immunity from infection through the sinus tonsillaris.

The function of the tonsil and the effect of its complete removal upon the general condition of the patient must be considered; so also, must the question of hemorrhage. In reference to the effect of the removal of the tonsil upon the general system it may be said that there is little evidence that it has any deleterious result. Masini, however, believes that the tonsil has an internal secretion comparable with that given off by the suprarenal gland. He arrived at this conclusion after experiments with the aqueous extract of the tonsil, intravenous injections of which gave the same results as obtained from the injection of suprarenal extract.

The last word concerning the treatment of the tonsil can not be spoken until its exact function is established. Clinically, there is little to show evil effects from its removal, whereas there is much evidence to show the good resulting from its removal, especially its complete removal.

I have attempted its complete removal with the capsule intact in about 400 tonsils during the past four years, and, barring one or two instances in which there was a temporary paresis of the palatopharyngeus muscle and a half dozen moderate hemorrhages, I have seen no untoward result. The general health of many was greatly improved and recurrent septic inflammation within the sinus tonsillaris has been eliminated. Recurrence of the tonsillar tissue has not taken place in a single instance. The fact of its regrowth is almost prima facie evidence that the entire tonsil was not removed. I will not attempt to deny that follicular tissue can be removed from the sinus tonsillaris after the complete removal of the tonsil, and that follicular tissue may develop within the sinus tonsillaris. But this should not be mistaken for the recurrence of the tonsil. The tonsil is an encapsulated mass of lymphoid tissue characterized by numerous crypts.

Having removed the entire tonsil with its fibrous envelope and its crypts, the chief source of infection is removed. It is, of course, possible for the follicular tissue which surrounds the tonsil to become diseased, but this should be differentiated from tonsillar disease. When the tonsil is not removed with its capsule intact, it is, of course, impossible to determine whether it has been entirely removed; and if a part of it is left regeneration might well take place. With these facts in mind, it is apparent that the complete removal of the tonsil should show a distinctly defined mass of lymphoid tissue enveloped within a fibrous capsule on its outer, and with mucous membrane on its inner aspect. Lymphoid tissue which is not thus characterized is not tonsil tisue.

Hemorrhage.—The danger from hemorrhage, is, perhaps, the greatest "bugbear" of the operation. Is this a real or an imaginary obstacle? It is both. It is real in so far as severe hemorrhage does occasionally occur in tonsil operations. It is imaginary in so far as the reputed frequency of its occurrence, and the degree of the danger attending it. A clear knowledge of the possible sources of hemorrhage will enable the operator to largely exclude its occurrence. Furthermore, there are certain matters in the technic of local anesthesia, and in the after-treatment, which, if properly applied, will greatly reduce the frequency and amount of hemorrhage. Clinically, I have observed that the most frequent site of arterial hemorrhage is, at about the middle portion of the sinus tonsillaris, where the tonsillar branch of the facial pierces the superior constrictor muscle of the pharynx. Other points of hemorrhage are usually limited to the inferior portion of the sinus tonsillaris where the tonsillar venous plexus is located, and to the anterior and posterior pillars.

In another part of this paper I have referred to the fact that three arteries, the tonsillar, the ascending palatine, and the ascending pharyngeal, pass upward on the outside of the superior constrictor muscle which they pierce as they turn inward to ramify the tonsil and faucial pillars. Just before entering the tonsil they break up into several branches. It is obvious that the smaller the branches cut during an operation, the less serious the hemorrhage. The clinical application of this fact is that if the arterial branches are severed as they enter the capsule of the tonsil the liability to hemorrhage is reduced to the minimum; whereas, if they are severed on the outer aspect of the superior constrictor muscle before they are broken up into smaller branches, the danger from both primary and secondary hemorrhage is greatly increased. It may be said that the operator should not injure the superior constrictor muscle in this operation, and this is true. Indeed if he thoroughly appreciates the clinical significance of the anatomy of the tonsillar region he probably will not injure it. There's the rub.

As to the anterior pillar, it should be borne in mind that there are arterial twigs coursing upward through it. The main trunks of the arterial branches are external to the palatoglossus muscle. Hence it follows that in order to injure them it is necessary either to pass the instrument behind the muscle and thus injure them, or to include the musculature of the anterior pillar in the grasp of the tonsillitome, knives, blunt dissectors or scissors, etc., and thus sever the muscle and vessels of the anterior pillar. The same statements may be made in reference to the posterior pillar.

The technique should, therefore, be such as to avoid injury of the muscles bounding the sinus tonsillaris, namely, the superior constrictor of the pharynx, the palatoglossus and the palatopharyngeus muscles, as by so doing the larger trunks of the tonsillar arteries are injured.

The technic of the complete enucleation of the tonsil with its capsule intact is shown in the following illustrations:

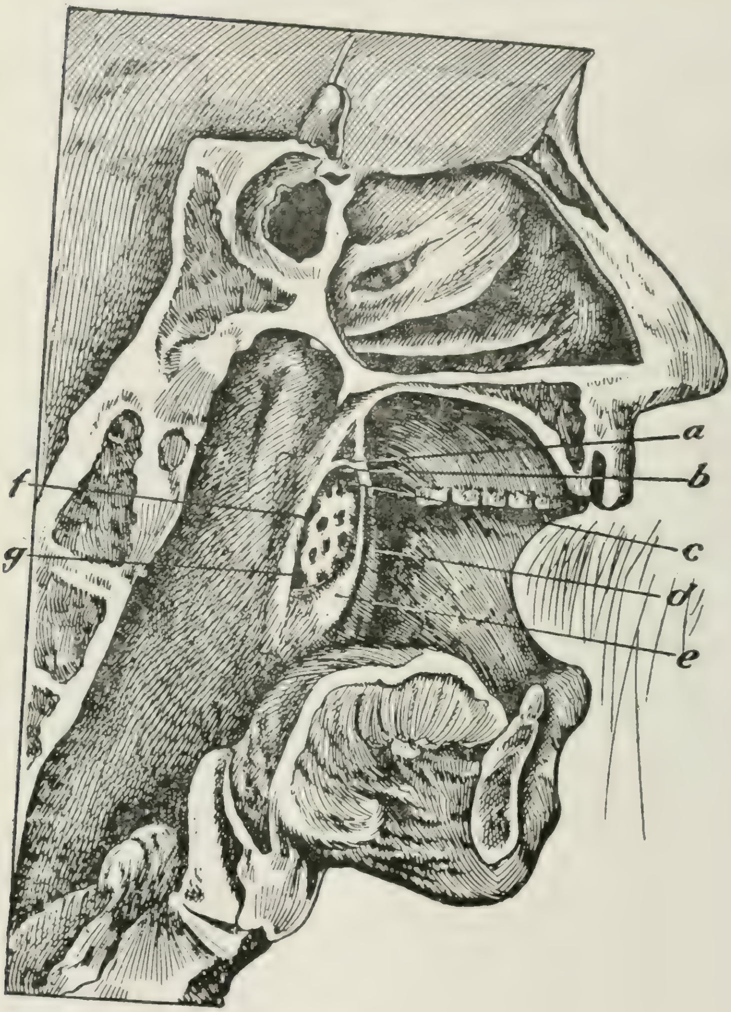

Fig. 1.

Fig. 1.—(a) Supratonsiliar border. The membrane covering the supratonsillar fossa is known as the supratonsillar fold. The supratonsillar margin is the edge of this membrane. (b) Supratonsillar fossa. (c) Openings of the supratonsillar crypts. (d) Anterior pillar. (e) Triangle fold. (f) Posterior pillar. (g) A large deep crypt under the inferior portion of the posterior pillar. This crypt often retains secretions and bacteria and gives rise to local and general trouble.

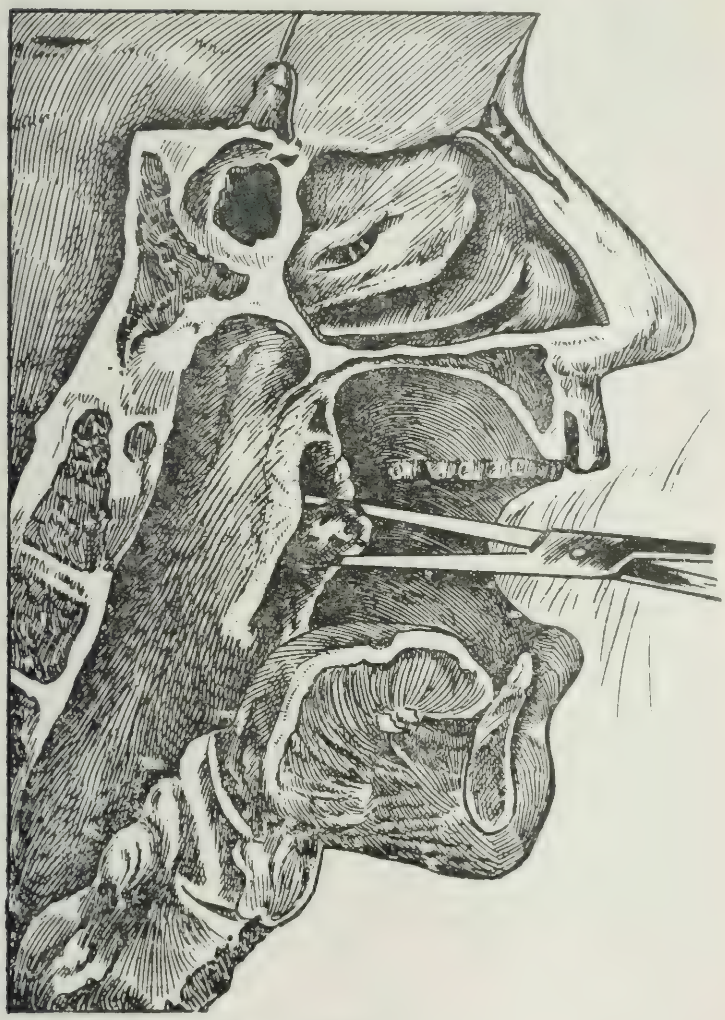

Fig. 2.

Fig. 2.—Showing the tonsil firmly grasped by the tenaculum forceps. The upper point of the forceps is in the supratonsillar fossa, while the lower is in the base of the tonsil. The mass of the latter is thus compressing between the blades of the instrument. Traction within and forward stretches the pillars and triangular fold and permits dissection. It also, as shown by Wilson, draws the tonsil away from the internal carotid.

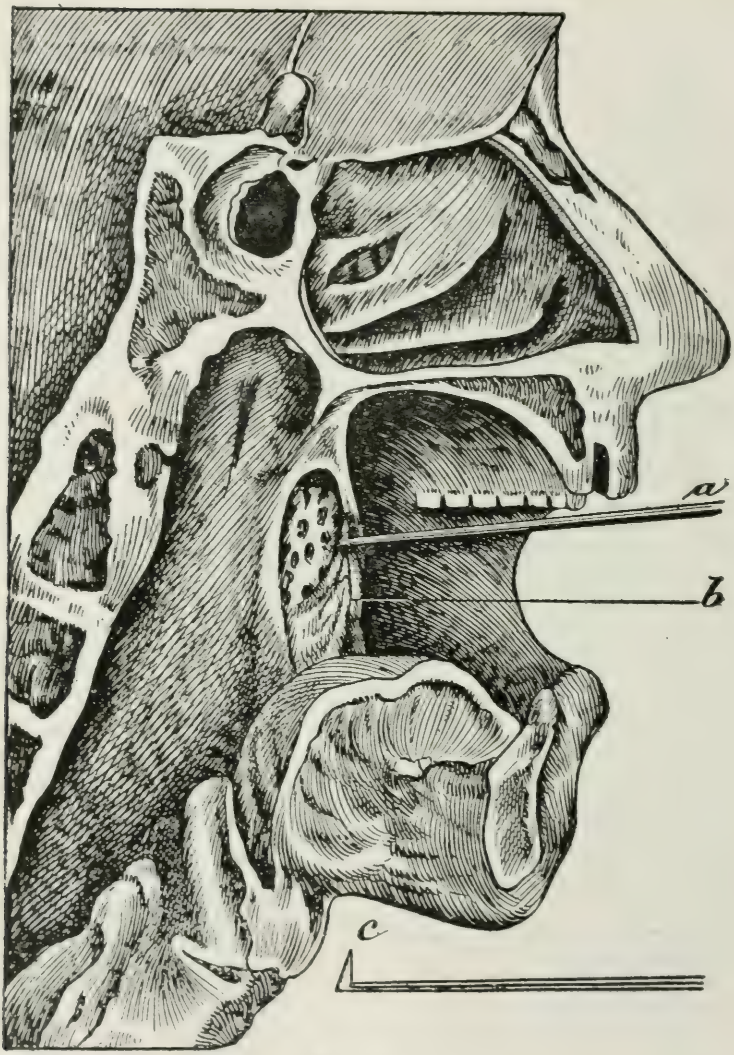

Fig. 3.

Fig. 3.—Showing the anterior pillar in the method of dissection by the Kyle right-angle knife. The bent blade is inserted into the mucosa at **b** and raised to **a** without cutting it; it thus includes a larger mucous surface. It should at once be drawn inward and forward, thus making an incision from **a** to **b**. The incisions should be prolonged so that the blade passes back to the region of the upper part of the tonsil and midway almost toward the base of the posterior pillar (see Fig. 4). The incision along the anterior pillar should begin at the junction of the pillar and the triangular fold. This will be rendered more easy by seizing the tonsil in the manner shown in Fig. 2 and drawing it inward and forward. Thus seized the tonsil may be turned up, either in its lateral or vertical axis, and thus the posterior pillar is put into a position such that the knife has easy access. (c) Kyle's right-angled bistoury.

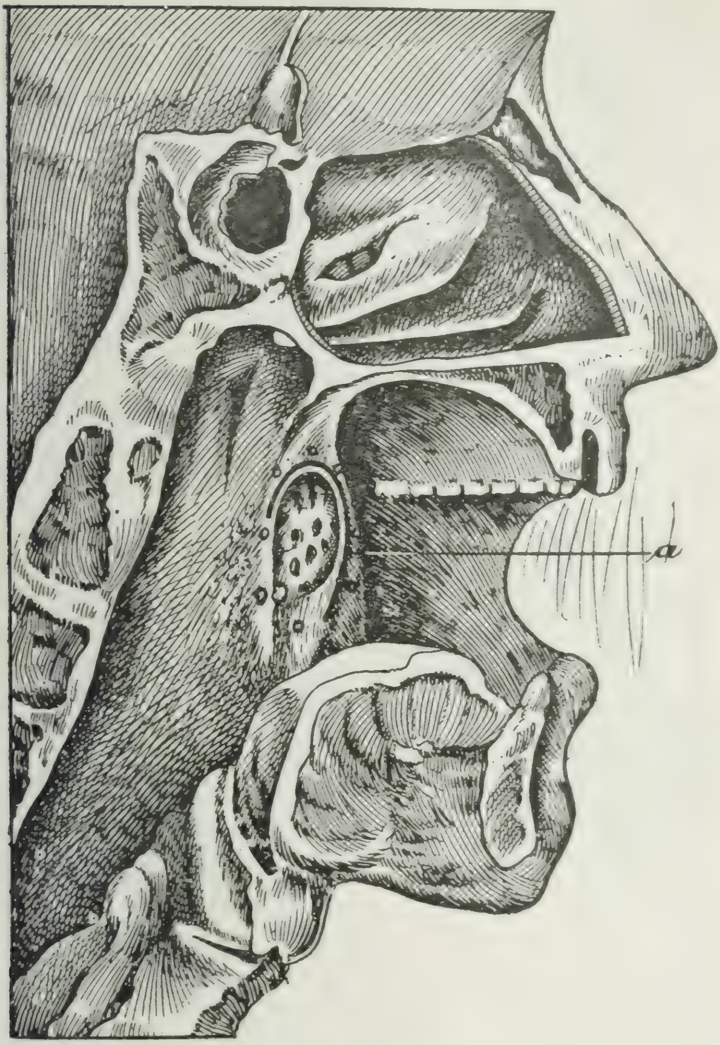

Fig. 4.

Fig. 4.—Showing the extent of the incision. Disengagement of the anterior pillar from the triangular fold—breaking up adhesions—is important. The triangular fold is removed with the tonsil. The sėven small circles about the tonsil indicate the points for injecting the cocain-adrenalin mixture.

The formula recommended by Dr. Moss is as follows:

℞ Adrenalin, 1 to 2000.
Cocain hydrochlorate q. s. to make 2 per cent.

There should be injected at each of the points indicated 2 or 3 divisions of the syringe. The anesthesia is immediate and complete and hemorrhage is almost completely prevented. In a series of 50 cases, there was only a single case of cocain poisoning, and it was not serious.

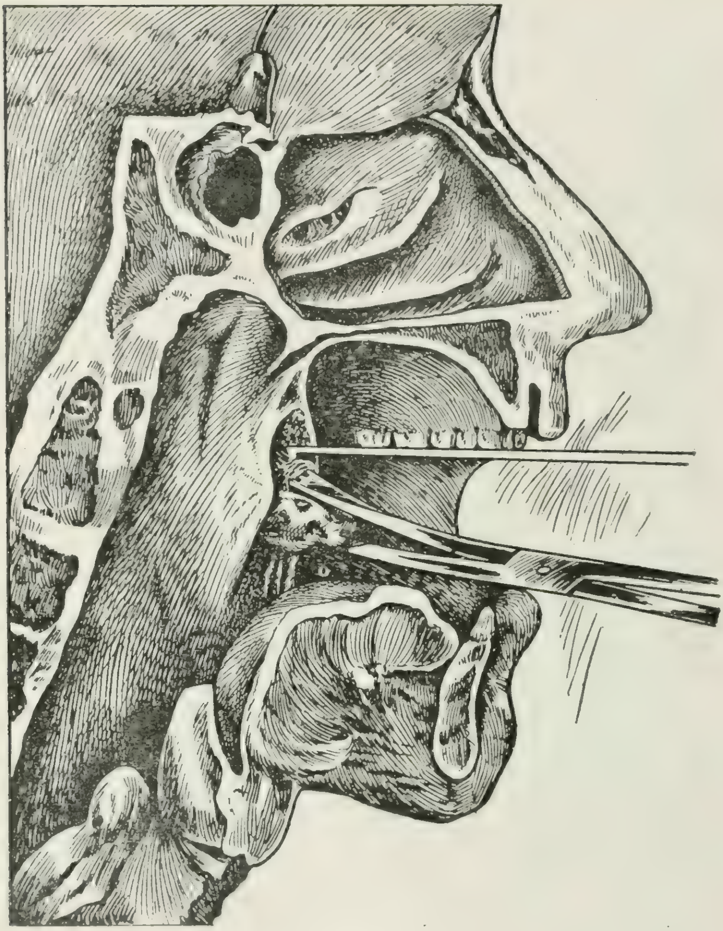

Fig. 5.

Fig. 5.—After having separated the pillars from the tonsil and triangular fold, the dissection is continued with the Kyle bistoury. The tonsil is seized deeply with the tenacular and drawn inward and forward. Thus the fibrous ligaments fixing it to the aponeurosis covering the superior constrictor of the pharynx are disengaged. These ligaments must be cut with the knife close to the fibrous capsule of the tonsil, taking care to avoid wounding the superior constrictor. In dissecting the tonsil capsule only a few small arterioles are cut, while if the muscle is cut, larger arterial branches will be divided and the hemorrhage will be greater.

It is necessary for the bistoury to be sharp. Secondary hemorrhage is often due to septic infection of a clot. Infection takes place more easily in a contused wound than in an incised one, hence the advantage of using a sharp instrument.

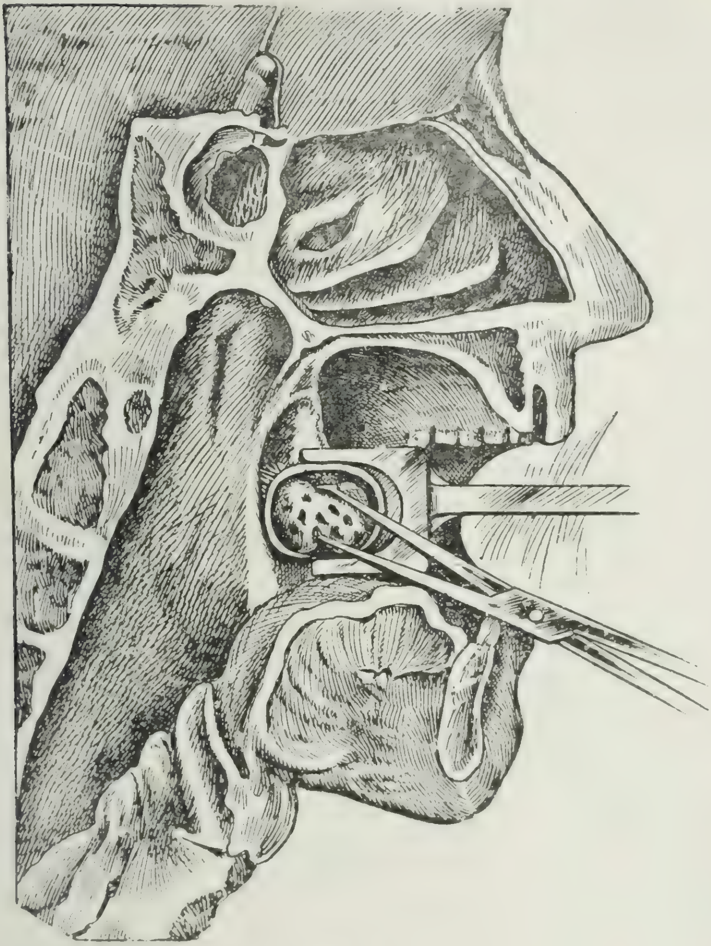

Fig. 6.

Fig. 6.—Showing the writer's ecraseur tonsillotome completing the ablation of the tonsil after its partial enucleation by dissection with the Kyle knife. It is better from a surgical viewpoint to complete the dissection with a sharp bistoury, if possible; secondary hemorrhage is less likely to occur. The chief difficulty is that the tongue often hinders this step. The ecraseur takes the place of the snare and it is always ready for use without introducing a wire or other cutting agent.

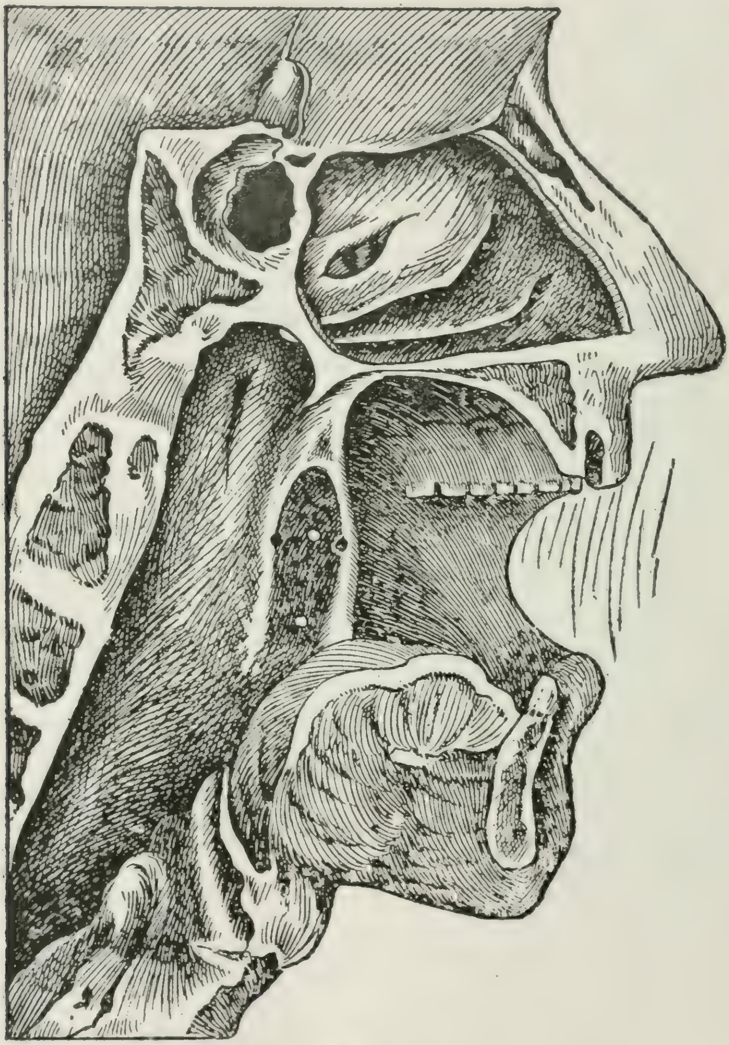

Fig. 7.

Fig. 7.—Showing the site of the tonsil after complete enucleation of the latter with capsule intact. The upper white point has been the region where, in the author's operations, hemorrhage most frequently took place. The lower white point is the seat of the tonsillar venous plexus. The black points upon the pillars are other sites of arterial hemorrhage when the musculature of the pillar is wounded.

LXXXI.

SOME OBSERVATIONS OF SUBMUCOUS RESECTION OF THE NASAL SEPTUM BY THE OPEN METHOD.

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No operation in the domain of rhinologic practice has so quickly and justly become popular as that of submucous resection of the septum narium. That it is adapted to the correction of nearly every form of deflections and exostoses, is now generally conceded. While the literature has become burdensome, and the instrumentarium a constantly increasing factor, the workers in this line have been simplifying methods, perhaps not always to the betterment of the operation, but certainly to its popularization. Simplicity, however, at the sacrifice of thoroughness, has been a tendency that should be criticised, and the aim should be here, as in other surgical procedures, to obtain a result as perfect as possible. Adopting the incision and the instruments as first recommended in this country by Freer, when his early articles were written, an increasing experience has demonstrated to my satisfaction, that for perfection of detail and result, they are all that can be desired in this operation.

There are some things that experience has emphasized, and to a few of them it seems desirable to call attention. In the adoption of the anterior reversed "L" flap, an open method is obtained, the advantages of which do not seem to be appreciated by many operators. The main reason for it is that it undoubtedly furnishes easier access to the operative field than any other, and permits most minute inspection of every part during the progress of the operation, nothing being done in the dark or at haphazard. I deprecate the tendency of many good operators to ignore this, and cannot but venture the belief that this often leads to a poor result, in which projecting remnants of the septum are left above and below the portion of the main deflection which is easily excised by whatever method used, but the excision of this portion of the deviation alone often leaves an imperfect result. The reversed "L" flap has to be dissected upward and forward toward the anterior angle of the patient's nose, and probably the supposed difficulty of accomplishing this has deterred many from using it. I have found, as a matter of fact, that if the incisions outlining the flap have severed the perichondrium, it is, as a rule, easily reflected forward with a dull edged elevator, if the ala of the nose is well retracted and the head of the patient is held so that the side of the face is partly toward the operator, as this position exposes the side of the septum and the site of the flap perfectly to view. When the flap has been dissected up it is easily held out of the way in the anterior angle of the nose, by retractors. One of the main advantages of this flap, when thus made, is that it affords easy access to the field of operation. The perpendicular incision having been made at the summit of the angle of the septum, the denudation of the crest begins here and it is usually quite easy to continue it backward from this incision, much more so than when the cut has been made, after the Killian recommendation, anterior to the crest. Another important merit of this incision is that it much simplifies the cutting through the cartilage. When the flap is reflected the operator has before him a snow-white bared surface of semi-transparent cartilage, in which the movement of the edge of the knife is distinctly visible. This view, and the tactile sense, show perfectly when the edge of the knife has cut entirely through the cartilage, and there is little danger of cutting through the mucous membrane of the opposite side. He soon finds that he has little fear of this accident to the membrane of the opposite side, for he can watch his blade in the cartilage, and by turning it slightly on the flat, uplift the severed edge of the cartilage as soon as he has penetrated it, and immediately begin dissection of the membrane on the concave side. Where the Killian incision and its modifications are used, the incision through the mucous membrane and the cartilage coincide, the cartilage lying buried beneath a varying thickness of membrane. It is, therefore, difficult for the operator to tell when he has fully severed both. Without doubt this has been the reason for the suggestions that have been made of the tedious process of curetting through the cartilage with a sharp spoon or other scraping instrument, the operator feeling in the other nostril for the evidence of penetration and being relieved if a hole has not been punched in the mucous membrane of the other side. Another thing is to be considered, namely, that this method of scratching through gives a small hole only through the cartilage furnishing an inadequate field for the rapid denudation of the concave side of the deviation. The flap method, on the other hand, permits the exact division of the cartilage in front, with a keen blade, and a large cartilaginous flap may at once be outlined, which gives the widest approach to the concavity of the septum, all of which can then be dissected under the eye of the operator.

The button-hole incision, and the removal of a large cartilaginous and bony deflection of the septum through a small opening, is alluring, and the boasted ease with which some operators have declared the operation can be done has led many to adopt a method that has resulted in half success, with a subsequent dissatisfaction with the results of the operation. With the open method, I am satisfied this defeat of its purpose would be scarcely possible. The protection of the incision, through the cartilage, by the flap which should cover it perfectly, would prevent perforations of the septum far in front, a most undesirable and annoying complication.

When the dissection of the mucous membrane on both sides of the septum has been completed, the removal of the cartilage is the easiest part of the operation, by whatever method it may be done. The rapidity with which this is accomplished is not important. The all-important thing is the complete removal of the obstruction, and the subsequent relief of the patient. This involves the operation upon both bone and cartilage in nearly all cases.

The theoretical objection that the flap method leaves a raw surface to granulate after the operation, is not tenable, for, when the opposing surfaces are brought into close contact by the tight packing with narrow strips of surgeon's lint impregnated with bismuth subnitrate, built up in layers from the bottom of the cavity like a wall and which remain for four or five days, it will be found that the parts have healed by first intention. This method of packing, and the free drainage furnished by the incisions, make impossible any collection of blood or fluids between the opposing layers of mucosa perichondrium or mucosa periosteum, a complication that has been noted sometimes in the single line incision.

The superior maxillary crest is so commonly an important part of the obstruction in deflections that its removal should be accomplished, in part at least, in nearly every case. This is often the most difficult feature of the whole operation, but the success with which this is done will determine whether it has been entirely satisfactory or not. The denudation of the crista of its overlying mucosa, because of its tenacious adhesion to the bone, makes the use of a sharp elevator absolutely necessary. The most suitable instrument for this purpose is the "A" knife of the set. There is great danger of perforation if the dull elevator is employed, and much force used. The crista is often so buried in its coverings that it is invisible and must be felt for carefully. It can always be exposed from above, and the "A" knife can be carefully passed down close to the bone beneath the mucous membrane on both sides, finally exposing it to the floor of the nares. It would hardly seem necessary to complicate the operation by making an incision across the nasal floor, and dissecting upward, as suggested by Yankauer. For cutting away the bared bone, the strong and larger forceps are often necessary on account of its exceeding density. With the patient sitting upright in the chair, the position assumed by the operator is a half crouch, with the kness bent, bearing down toward the floor of the nares with the jaws of the forceps, slipped over a portion of the crista. It can easily be removed with successive bites of the instrument. The smaller forceps are often required for removing remaining portions of the cartilaginous deflection above or of the vomer behind.

There is no doubt that the preservation of the perichondrium and periosteum is essential to the restoration of rigidity of the septum. When we remember that the mucosa is quite freely movable upon these and that they lie in distinct layers, it will be seen that it is the mucous membrane alone that would probably be lifted in many cases, if the parts cannot be under direct inspection. The result would be a flaccid and baggy condition of the septum, which would make respiration little less difficult, in some cases, than it was before the deflection had been removed. Heavy instruments and blind force used in elevating the mucosa, inevitably result in violence to the soft parts, inflaming them and lessening their vitality, or making perforations. With keen dissection and gentle elevation, such complications are rare, even the site of close adhesions that follow previous sawing or cutting operations yielding to this delicate and careful surgery. I have demonstrated its efficacy in children, and it is largely due to the minimum of mechanical injury as well as the painlessness of the operation.

The painlessness of the operation on the septum has been demonstrated many times when the anesthesia has been induced by the application of cocain crystals to the mucous membrane. I am convinced that its use in the way here recommended is no more dangerous than by the usual method with watery solutions of varying strengths. Indeed, I have yet to see any toxic effect to any marked degree in my own operations, and Freer's record of nearly two hundred cases in which he has applied it in this way, would tend to prove that it has not the elements of danger that have been claimed in some discussions. There are undoubtedly individuals who are extremely and dangerously susceptible to the toxic effects of cocain in any strength of solution. I believe the applications of cocain, as recommended by others, to induce local anesthesia, are as dangerous as when used in the concentrated form, if applied as here suggested. The anesthetic is brought into contact with the highly vascular turbinated bodies as little as possible, as it seems to pass rapidly into the circulation from them. I have seen more toxic effects, and in a larger proportion of cases, from the application of a four per cent solution of cocain to the turbinated bodies, than from the application of the crystals of the same drug to the septum alone. Only small quantities are used, and they are applied to the site of operation Immediately preceding the cocain, a fresh 1-1000 solution of adrenalin chloride is used and the membrane of the septum is thoroughly decongested. By limiting absorption this probably lessens the danger of toxicity.

The method employed is to first swab the entire nasal mucous membrane with a 1-1000 solution of fresh adrenalin chloride. In five minutes the cocain crystals are carefully applied to both sides of the septum, being entangled in a small pledget of moistened cotton which has been wound tightly on the end of a slender probe. The cocain is rather freely used, but care is taken to rub it only over the site of the operation, which usually includes the cartilaginous septum and the anterior portion of the vomer. In five minutes the anesthesia will be found complete. During the progress of the operation it may be used both as an anesthetic and as a hemostatic. For the latter it often does better than the adrenalin, which acts promptly and efficiently in most cases.

LXXXII.

THE CATHETERIZATION TREATMENT OF ACUTE FRONTAL SINUS INFLAMMATIONS BY THE INTERNAL METHOD.

By Holbrook Curtis, M. D.,

NEW YORK.

The external methods employed in the operative treatment of frontal sinus empyemata have occupied so much space in rhinologic literature of late, that a word as to a more conservative method of dealing with this interesting condition may not be amiss. In 1902 a paper was read by the writer before the American Laryngological, Rhinological and Otological Society, in Washington, entitled "The Technic of Frontal Sinus Operations with Reports of Three Cases Treated Without Nasal Drainage."*

These cases which were exhibted at the New York Academy of Medicine in the May meeting of that year, were the first cases in which the method of open wound dressing, similar in every particular to the dressing employed in the after-treatment of a mastoid abscess was advocated. Since that time some surgeons have gone to such extremes in their desire to operate externally that more conservative methods have been disregarded. A reason which has led to the popularity of the external methods of operating in almost every case is undoubtedly because of the erroneous opinion which prevails that the internal method of entering the frontal sinus is fraught with great danger to life. Unhappily, this belief has caused an unsightly scar upon the brow of many victims of the surgeon's prejudice.

From the opposite point of view, the operator may point to the sinus lined with polypoid tissue and ask, could that ever have been cured without a curettage of the cavity? My answer to this question would be to point to many cases upon which an operation has been advised by the surgeon and refused by the patient, in which careful treatment, as indicated below, if it has not been curative in a physiologic sense, has relieved the patient of all his pain and discomfort.

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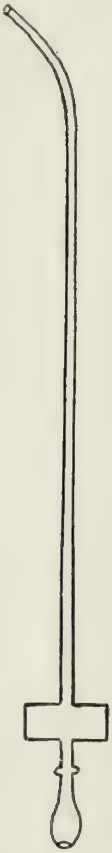
*Laryngoscope, July, 1902.

Far be it for me to decry the external operation, for in the



hands of the skillful operator the most brilliant results are attained. The method advocated in this sketch is one which in the writer's opinion should precede the radical external operation in almost every instance, both on account of its simplicity and utility. It is surprising how many apparently chronic cases will cease discharging pus after two weeks' treatment. The patient is taught to introduce the catheter himself and to douche as frequently as the condition warrants.

The illustration shows the catheter employed for douching, which is made of silver by Tieman.

The method of entering the frontonasal duct is as follows:

Cocain hydrochlorate, 10 per cent solution, one part, and adrenalin chlorid 1-1000 solution, one part, are mixed and applied on a cotton pledget for twelve minutes to the anterior tip of the middle turbinate body and roof of the middle meatus.

The tip is next removed by Grünwald forceps and the snare, exposing the ethmoid cells between the internal lamella of the ethmoid and the orbital plate. A small cutting forceps is then employed, in the direction from the middle of the vestibule toward an imaginary line a centimeter below a line which would pass through the inner canthus of both eyes, and the cells are broken down. A blunt barrel drill run by an electric motor completes the removal of these cells.

It is easy to feel the greater resistance of the internal lamella and orbital plate while operating. After the turbinate is removed, we frequently find that the cell structures are so delicate that any blunt instrument like an Eustachian catheter is sufficient to break them down. If we are careful to keep outside the lamella and hug the orbital wall, we need not fear penetrating the cribriform plate.

In using the probe end barrel drill on older persons with hard cell walls, care should be taken to cut in a forward direction, using the forefinger on the upper lip as a fulcrum and inclining the drill at a radius more toward the perpendicular as we break down the cells from behind forwards. One feels at once when the frontonasal duct is encountered, a fact which we verify by catheterizing and syringing. The patient is always able to tell when the warm antiseptic solution enters the sinus. He generally feels it "back of his eye and in his forehead." This operation upon the living subject is a very simple procedure, however complex it may appear upon the skull.

The sinus catheter is made with a bulb to slip into the tube of an Amberg ear syringe, and has a plate to indicate the direction of the beak, as well as for the purpose of holding the instrument firmly. I do this operation so frequently in my office as a routine procedure that I regret I have not tabulated my cases carefully, but in considerably over one hundred and fifty cases operated upon, I have never had any untoward accident whatsoever.

So much for the danger of procedure.

As regards the results obtained, it may be said that they are curative in acute cases and in chronic conditions afford so much relief that many patients who have been advised that an external operation is imperative, are content to treat themselves by douching their sinuses as necessity demands. The number of cases that are free from pus after a year of douching, is remarkable—and not in accordance with theoretical presumption. Later, it is the intention of the writer to collect statistics from cases, many of which have escaped observation, and elaborate a more extensive article on the subject of frontal sinus treatment.

In illustration I cite a few cases in which douching the sinus has been employed.

Case I.—Miss B., saleswoman, age 35. Has had excruciating pain over left eye, accompanied with profuse discharge from left nostril for a period of over ten years. Inferior plate of sinus very sensitive, eyelid frequently swollen. Would not submit to external operation. Operated internally in March last and douched. Patient has continued douching only when she takes cold, as at other times the discharge is insignificant and pain has entirely ceased. Sometimes there is no discharge for two weeks.

Case II.—Mr. J., age 55. For twenty years has suffered from "facial neuralgia, followed within a few days by a violent catarrh after every attack." Pain has been so severe that morphin hypodermically became a routine treatment. Attacks occurred about four times a year. More or less persistent discharge from right nostril. Patient was operated upon in April, 1903, and the right sinus douched daily for two weeks, since which time the pain and discharge only occur upon taking cold and are readily overcome by two or three hot boric douches through the catheter. In this case an external operation was apparently justified.

Case III.—Mr. B., age 35. Has had a double frontal sinusitis and both antra affected. Most violent pain a symptom. Returned from hunting trip in agony after a two weeks' awful experience. Operation in February last, consisted in entering both frontal sinuses and douching. Two days afterward operated on the antra by perforating the inferior meatus walls. All four sinuses were syringed every few hours with hot antiseptic solution, which stopped the pain almost immediately. All discharge stopped only after four weeks' continued irrigation.

Case IV.—Mrs. D., age 37. Presented herself in September, 1903, in great pain over the left eye, with profuse discharge from left nostril. I had done a radical antrum operation through the canine fossa the year previously. Pain was so intense that she begged me to perform the external operation upon her sinus. I persuaded the patient to allow me to operate within and catheterize the cavity, which proceeding stopped the pain and the discharge disappeared within two weeks. There has been no recurrence.

I might append scores of similar cases, but it seems unnecessary in a brief sketch of this interesting subject.

LXXXIII.

ON THE PERMANENCE OF THE IMPROVEMENT IN THE SHAPE OF THE NOSE OBTAINED BY THE SUBCUTANEOUS INJECTION OF HARD PARAFFIN.

By Walker Downie, M. B.,

LECTURER ON DISEASES OF THE NOSE AND THROAT, GLASGOW UNIVERSITY AND WESTERN INFIRMARY.

It is now close on five years since I first made use of a preparation of hard paraffin, injected subcutaneously, for the removal of deformities of the nose.

In the interval I have, on more than one occasion, demonstrated the good results obtained. The improvement which follows the operation is evident to any unprejudiced observer, and in almost every case is the patient well pleased with the result.

Of the many questions which have from time to time been asked of me regarding the behavior of the injected paraffin, two stand out prominently, namely: (a) Is the paraffin after injection affected by heat? and (b) Is the improvement, obtained from its use permanent?

As these are questions of the first importance, and points on which the patient should be fully satisfied prior to the performance of the operation, I will, by way of answer, refer to my own experience.

1. What is the effect of exposure to heat? Is the paraffin in any way affected or altered when the patient is exposed to a high temperature subsequent to the operation, either from residence in a tropical climate or from the exposure of the face to great heat, such as is necessary in the pursuit of certain occupations?

So far as my experience goes, climate exercises no effect whatever on the paraffin lying in the subcutaneous tissues.

Amongst the many patients on whom I have operated, are men resident in various countries where the temperature is that of the tropics, in India—Burma, Bengal and Bombay—

in South America and South Africa. In none of those cases, so far as I am aware, does the paraffin appear to have been altered or affected in any way by the hot climate, nor has the deformity recurred.

Again, several of the men on whom I have operated in hospital are employed in some of the large iron and steel works for which the upper ward of Lanarkshire is famous, and in none of them has the injected paraffin been apparently affected by exposure to the heat radiating from the molten metal or from the boiler furnace.

The first case in which I employed hard paraffin for the removal of a deformity of the nose was that of a woman, and who, for purposes of observation, was detained as an in-patient for some weeks, during which time she willingly assisted the nurses in the work of the ward. On one occasion she was set to smooth some cloth with a hot iron. She went to the ward kitchen to do it, but returned shortly, saying she was tired, and went to bed. Next day she confided in the ward sister and told her that she had not really been tired but she feared that the heat from the iron would melt her nose. She has now, for five years, been doing all kinds of household work—cooking, ironing, etc.—and the shape of her nose to-day is practically identical with the form shown in the photograph taken two weeks after the injection had been made.

2. Is the improvement brought about by the introduction of the paraffin permanent? Does the injected paraffin remain *in situ* as time goes on, does it migrate, or does it become absorbed?

Some observers contend that the injected paraffin is slowly resorbed or "swallowed up" by the tissues, a process similar to the resorption or "healing in" of a properly prepared catgut ligature. When this process is complete, they say, the parts return to the condition they were in prior to the injection, i. e., the deformity reappears. Others think that by some unexplained process, the paraffin, while not becoming absorbed, disappears or is dispersed, so that the deformity recurs in time; while others again have said that the injected paraffin becomes in time replaced by fibrous tissue, the presence of which prevents the reappearance of the deformity, or the deformity, at least, is less evident than prior to the injection.

On the 2nd of March, 1906, I made some remarks on this subject at a meeting of the Laryngological Society of London, and I illustrated my remarks by the exhibition of photographs of patients who had been operated upon.

These photographs showed (1) the kind and degree of deformity of the nose before operation, (2) the improvement which immediately followed the introduction of the paraffin into the subcutaneous cellular tissue and (3) the shape of the nose in each of those same patients, four years after the operation.

All who saw the photographs were convinced that the shape of the nose as shown (a) in the photographs taken about two weeks after the operation and (b) those taken four years later was practically identical, and that there was no evidence of the reappearance of the deformity which was shown to have existed, by the photographs taken prior to the operation.

But further than this. When those cases were examined four, and in several instances considerably over four, years after operation, the injected paraffin could be felt as a well-defined mass, readily caught up between the finger and thumb, occupying the same site as it did immediately after the injection had been given.

In each case a hard mass could be felt at the site of injection, and in none of the cases had the deformity recurred.

I, therefore, hold that the improvement which follows the careful subcutaneous injection of hard paraffin is, for all intents and purposes, permanent in the majority of instances, and probably it is so in every case where the paraffin has been properly introduced.

I also hold that the paraffin remains *in situ* indefinitely. This latter opinion is based on two grounds:

1. The character and shape of the mass felt beneath the skin when examined externally with fingers.

When the body is grasped between the finger and thumb it is hard and somewhat rounded, quite unlike bands of fibrous tissue, and its size and position are similar to those of the paraffin tumor as felt on examination immediately after its introduction.

2. The nature and appearance of the paraffin when removed from the tissues months and years after its introduction.

I have on three occasions been called upon to remove paraffin from the tissues, twice from the nose and once from the supraorbital region.

In one case the paraffin had been injected by a surgeon in Manchester with the object of raising the bridge of a sunken nose, and a quantity far in excess of the requirements had been introduced. The result was a nose enormously swollen externally and livid in color, with considerable nasal obstruction. The latter was caused by the presence of a series of hard tumor-like swellings within the nose, consisting of hard paraffin beneath the mucosa. I removed the paraffin which formed the tumor-like swellings, together with much of that which caused the abnormal tension of the skin.

Another case was a girl operated upon in a London hospital for the removal of a similar deformity of the nose, but where a quantity of paraffin had spread to the supraorbital region from which I dissected it out.

A third case had been operated on near Glasgow, where again the injected paraffin had spread beyond the confines of the nose, resulting in a disfiguring swelling over one eye, and which was also removed by the careful removal of the paraffin.

In each case the paraffin was found to be present, and to be in a state of fine division, in small rounded particles, separated by bands of tissue.

The finding of the paraffin in small particles is not to my mind the evidence of the early stage of absorption, for this division takes place at the time of injection. This I showed by the experimental injection of paraffin into a mamma one week before its removal. The conditions found on examination afterwards were reported by me at a meeting of the British Medical Association in 1902. In that communication I reported:

"In section the paraffin appears almost entirely in the deeper parts of the subcutaneous fat. It is distributed throughout this layer in blocks of varying size, the largest being perhaps about the size of a pea. These masses, which are either distinctly lobulated, or more irregular, with rounded processes, occupy in every case a position between collections of adipose vesicles which are displaced by them. It is inferred that the paraffin has made its way along the lines of connective tissue trabeculae between fat containing cells."

And I further expressed this opinion: "From the fact that the infiltration of the paraffin is definite and tolerably intimate, it is difficult to believe that its position would subsequently alter to any extent, although its absorption is possible."

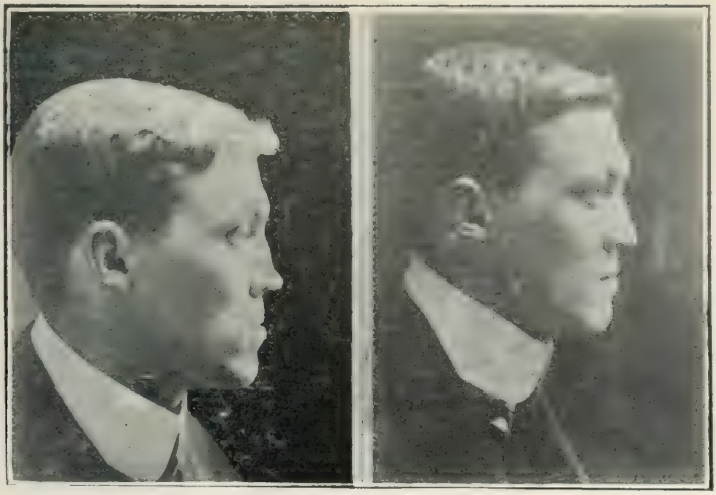
The paraffin breaks up on its introduction into the subcutaneous tissues: it runs along the cellular planes, and it is not eaten into later by the living tissues. The paraffin after injection is held in position by the trabeculae of the minute planes of cellular tissue in the same way as the fat of adipose tissue is kept in place.

Much has been spoken of the migration or wandering of paraffin after it has been injected. While the paraffin in the fluid state is being injected it, of course, follows the line of least resistance, and if permitted it may spread in various directions; but after it has once set, I have never seen it wander beyond the confines of the nose.

In those cases where the paraffin has been found in other parts of the face, such as the infraorbital region over the forehead or over the cheek, I fear it has reached those regions while the injection was being given and while the paraffin was still in a fluid state.

On the other hand, I can understand the wanderings of paraffin which has been introduced in the solid form, as this can never become so intimately incorporated with the tissues as when molten paraffin has been introduced.

The accompanying photographs, which are patients healed by paraffin injection, show the shape of the nose shortly before operation, and again at an interval, varying in the different cases, of from three to five years after operation.



LXXXIV.

A SHORT NOTE ON SUBMUCOUS RESECTION OF TRIANGULAR CARTILAGE.

By Richard Lake, F. R. C. S.,

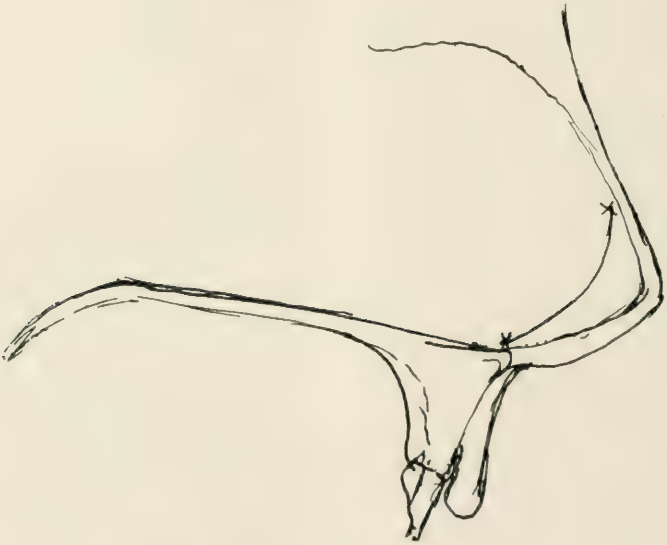
LONDON.

Much interest has of late centered round the operation of submucous resection of the triangular cartilage, one of the chief points being the employment of an incision through the mucoperichondrium over the triangular cartilage parallel to, or slanting obliquely up from the floor of the nasal cavity. A second incision is usually recommended at an angle to this one, proceeding upwards.

The former incision possesses two bad points. The first is, that the chief nutrient artery of the anterior septal region is severed with the nasal nerve on the incised side; the second, that the cartilage is not attacked at its free edge. Severing of the nutrient artery appears to me to be a serious consideration quite apart from the temporary though annoying hemorrhage that may be set up; first, because deficient nutrition must act deleteriously in the formation and growth of the new cartilage, which would be thin and very non-resilient; and secondly, that especially if attended with any weakening or injury of the mucosa on the concave side, it is apt to be followed by the appearance of a septal perforation.

This is a condition following the method of Asch with painful frequency and one which also quite commonly put in an appearance after the true "window" operation, which for that reason I ceased to employ in 1891 and which, subsequently, I believe became known as Gleason's, as the first to communicate it to the medical world. Not that a septal perforation is often even known of by the patients, but it seems foolish before the millennium to risk having skillful innuendoes let loose at one's expense by "brother" craftsmen, should such a patient stray into the hands of one not imbued with the ancient if antique spirit of etiquette. But although septal perforations are not always or often annoying, they are very often so, especially to patients who are more or less neurasthenic.

Therefore for two reasons, one for the patient and one for the surgeon, perforations if possible are to be shunned. As a further argument in favor of the advisability, if not absolute necessity, of avoiding the septal artery, I will refer my readers especially to Gerber's atlas and to his views on perforating ulcer of the septum. Also one must remember that the destruction of the sensory nerves leaves the areas they had supplied in a condition which renders them more easily affected by slight trauma, decreasing the resistance of the tissues.



How perforation is always to be avoided when an extensive opening is needed, I do not see, but of late I have been in the habit of making only one incision, as nearly as possible corresponding to the free edge of the triangular cartilage. This incision is almost bloodless, the free edge of the cartilage is found and freed from all soft tissues for a slight distance backwards, the mucoperichondrium is then held by an assistant with clutch forceps, also the columella which are retracted as far as possible. The operator proceeds to remove all of the cartilage he considers necessary, through his opening.

There is always the case in which a much lateralized spur affecting the nasal crest of the superior maxilla requires removal, and then this incision is not alone sufficient and should not be attempted, as it is scarcely possible to exert the necessary force on the sharp edge of bone and not tear through the mucosa.

Another point of especial importance, is that in a large proportion of our cases which require the correction of septal deformities, we find in addition irregularities of the turbinates which require careful and skillful correction in order to enable the new septum to be formed upright and straight, for the air channels should be as far as possible equal in size in order to obtain the best results, and personally the writer invariably uses thin and not too resilient splints.

Asepsis should be obtained and maintained by the use of a nasal wash or spray every two to four hours with a mild antiseptic; for choice 10 per cent of listerine, 5 per cent of acid boric or 5 per cent sanitas. And if any blood has been swallowed an aperient is advisable. Antipyrin, or its equivalent, will relieve the pain and any swelling may be combatted by the employment of an evaporating lotion applied constantly on lint to the nose.

LXXXV.

A CASE OF MULTIPLE RECURRING PAPILLOMATA OF THE LARYNX.

By Charles W. Richardson, M. D.,

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WASHINGTON.

During the month of January, 1905, there was brought under my care, in consultation, a young man, 32 years of age, who gave the following interesting history:

He stated that, since early childhood, he had more or less difficulty in breathing, and always a hoarse voice. During the last four or five years the voice has been continuously hoarse and rough, and the breathing more or less difficult. During the last two years, he had not spoken above a whispered voice, and the breathing during this period had been so difficult that it had been almost impossible for the patient to make any active physical efforts. He has had to be very cautious in going about. Several times during the month previous to his coming under my observation, he stated he had very violent attacks of difficult breathing, in which it was thought that the patient would suffocate—twice during the week previous and the night before he came to me he had attacks of intense dyspnea—which was the immediate cause of his seeking my aid. His general history was excellent, and there was no occasion to suspect anything of a tubercular character. There was no chest symptoms of any kind. He was tall — 6 feet 2 inches — rawboned and weighed 148 pounds. An examination of his upper air tract showed nothing other than normal. Inspection of the larynx revealed a condition which was rather astonishing. Over the whole left side of the rim of the epiglottis and extending down along its whole lateral border, there was one continuous mass of papillomatous tissue. The whole supracordal portion of the larynx seemed to be filled in with a mass of papillomatous tissue. No space could be seen which would indicate the interval between the vocal cords. These growths seemed to grow from the aryepiglotidean folds, from the false cords, from the anterior commissure and the whole of the surface of the true cords. The patient's embarrassed respiration and his general appearance excited my greatest sympathy. Recognizing the fact that I had to do with an extreme case of papillomatous degeneration of the whole mucous membrane of the larynx and the probability of eradicating the condition as thoroughly through the intralaryngeal method as through external methods, I decided to send the patient to the hospital where all arrangements were made to do a tracheotomy, in case that the intralaryngeal method should excite any violent paroxysms of dyspnea. The operation was attended with great good fortune and the growth was rapidly and successfully removed from the body of the larynx, from the epiglottis, from the aryepiglotidean folds and from the false and true cords. I then found that there was considerable growth in the subglottic portion of the larynx, especially on the right side. This was all thoroughly and carefully excised. In the summer the patient was practically free from all growth and was allowed to go abroad. Recurrence had been more or less frequent. During the operative stages, growths removed from one point would remain absent and then show up again after a period of two or three weeks or a month. Growth removed from the aryepiglottidean folds, and false cords showed less inclination to recur than those in the subglottic portion of the larynx. When the patient left me his weight had increased to 179 pounds, general health good, and appearance that of perfect physical well-being. In December he wrote me that he was getting more hoarse and that there had been a recurrence of difficult breathing. I advised him to consult Dr. Edward Law, in London, who, after examination, referred him to Sir Felix Semon. I append herewith a letter from Dr. Law, giving a critical extract from Sir Felix Semon's letter to him in reference to the patient's condition:

"On examination I found almost complete apparently papillomatous (I will at once say what I mean by apparently) degeneration of the larynx, involving both vocal cords, both ventricular bands (badly), the lower surfaces of the epiglottis, particularly on the left side, the mucous membrane over the arytenoid (partly) and a considerable part of the subglottic cavity, particularly on the left side. The movements of the vocal cords were impeded, but not abolished. On the left side, in the middle of the laryngeal degeneration, there appeared to be two cysts filled with grayish fluid. On the right side of the neck there was a big, moderately hard gland not fixed to the larynx. There were no chest symptoms of any kind.

At first sight I should quite agree with the diagnosis of papillomata, but the presence of the large gland drew my attention to the possibility of the whole affection being of lupoid character, and, the patient being 32 years of age, the remote possibility of malignancy must also not be lost sight of, although the extremely long duration of the symptoms (twenty-nine years) would, of course, militate against this hypothesis, unless one were to think of a transition of benign into malignant growths, which, although extremely rare, yet has, as you know, been a few times actually observed. A certainty on these mooted points will, of course, only be got by intralaryngeal removal of a good-sized fragment and careful examination on the part of an expert.

Needless to say, the question of treatment will have to depend to a great extent upon the results of the microscopic and bacteriological examination. If the disease were purely papillomatous, I should be more in favor of a repeated intralaryngeal removal than of an external operation, seeing that the degeneration is unfortunately so universal that even if the larynx were opened and everything thoroughly scraped, no binding promise could be given with regard to non-recurrence.

Should the disease be malignant, nothing short of total extirpation of the larynx and of the affected gland would give any chance of lasting cure.

Finally, should the disease be lupoid, extensive scraping, applications of the galvano-cautery, tuberculin injections under opsonic control would be the best method. I confess that the lupoid possibility only occurred to me after the patient had left me, and I did not discuss this possibility with him or his mother.

Should the intralaryngeal method be adopted, I would insist on the patient's going to a Home until the epiglottis was sufficiently cleared not to fear any sudden obstruction after the operation. Altogether, the case is anything but nice."

My patient, for various reasons, became dissatisfied with the condition of things in London and took the steamer and came immediately to Washington, where he placed himself again under my observation. I found the conditions about the same as described by Sir Felix Semon, except that there was no cyst. What Sir Felix thought was a cyst must have either ruptured or evacuated its contents before he came under my observation the second time. The large gland on the right side of the neck below the angle of the jaw was a broken down, cheesy gland, which I have removed. Both of the examinations made of the masses removed showed the growth to be a pure papilloma, without degenerate tissue of any kind being present. The patient returned to me the latter part of January, and is now, after many successful repeated efforts at removal, entirely cleared again of all growths. I simply report this case as one of the most interesting and most extensive with regard to new growth of the many cases of recurrent papillomata that has come under my observation.

I find no positive evidence to justify an opinion that the pieces of tissue from the epiglottis (or wherever they came from) are malignant. They present the appearances of epithelial papillomata, and, in places, proliferation of the surface epithelium is very marked. There are also evidences of inflammation which may be primary or secondary. Many of the papillae are infiltrated with polymorphonuclear leucocytes. There is absolutely no invasion of the underlying tissues of the epithelium. A small myxomatous area was found in one piece only. The appearances found in the sections indicated only papillomatous formations with slight inflammation.

LXXXVI.

A STATISTICAL REPORT OF THE RESULTS OF OPERATION IN SARCOMA OF THE NOSE BY METHODS GENERALLY ADOPTED, WITH A PLEA FOR THE MORE EXTENDED USE OF THE ELECTRO-CAUTERY IN SUITABLE CASES.

By J. Price-Brown, M. D.,

TORONTO.

Writers differ widely from each other in their general views in regard to this disease, and in introducing the subject a brief resumé of prevailing opinions may not be out of place.

Lennox-Browne in his voluminous work upon "Diseases of the Nose and Throat" does not even mention the existence of sarcoma of the nose.

Shurly says that myxosarcoma is the variety that occurs most frequently within the nose; and that the usual seat of growth is either the middle turbinal region or the external wall, thus granting the primary origin of the disease within the nasal cavity. He also says that while the original growth may be pedunculated, the pedicle is soon lost, the base rapidly becoming broader, until it finally loses itself in the mass of involved tissue.

Kyle, on the other hand, says that "primary sarcoma of the nose is not of frequent occurrence, but as a rule has its origin in adjacent structures, and spreads thence into the nasal cavity." He insists upon early and complete eradication as the best line of treatment, to be accomplished by the use of the curette and galvano-cautery.

Bosworth in his report of 41 cases treats of it as a primary affection, occurring in a single tumor, that may arise on the outer or inner wall of either nasal cavity. He further states that there is no clinical evidence in support of Weber's idea, that sarcoma is usually accompanied by several deposits of the same neoplasm in neighboring regions; and also, that the growth is soft and flabby, and that the tumor is invariably pedunculated.

Coakley says that sarcomatous degeneration is occasionally met with in cases of nasal polypi and other benign tumors, after these have been removed a number of times, a view which is accepted by many surgeons; and also, that the appearance of sarcoma within the nose may be the first evidence of the presence of sarcoma within the antrum. He says that the growth has a hard feel, as of solid tissue, and is not very movable even when of considerable size.

Harris, in a paper published several years ago, refers to a series of 103 cases, reported up to that date, including his own; and from the investigation of which he draws the following deductions: That round-celled and spindle-celled sarcomata are about equally frequent in their occurrence; that the cartilaginous septum is the part most frequently involved, and that next to this, the middle turbinal body; that it usually proceeds from a well-defined pedicle; that the growth is soft to touch and bleeds easily; and that "sarcoma is a small tumor, usually pedunculated, and rarely multiple." In speaking of treatment, he says that while many cases require removal by external radical operation, there are others in which an intranasal operation alone is justifiable; but that no matter how treated, more than half the cases are ultimately fatal.

Halsted believes that the period of life most susceptible to this disease is between the fortieth and the fiftieth years. His graphic description of the symptoms is worth repeating: "the conspicuous absence of pain while the disease is confined to the soft tissues; the presence of epistaxis as a prominent symptom; the nasal obstruction so great that both breathing and eating become distressing to the patient; while speech becomes difficult and the senses of smell and taste are either lost or severely impaired; until finally, as the disease advances into the accessory sinuses or the cranial cavity, pain becomes severe and continuous; and death either from sepsis or exhaustion is the result."

In order to bring the results of the investigation down to the most recent date in the preparation of this paper, I sent one hundred circulars to leading laryngologists in the United States and Canada, and as a result, I received about fifty replies. Although not by any means as satisfactory as one would like, they contain much valuable information, and I extend to the gentlemen, who forwarded the answers, my most cordial thanks. A synopsis of these reports I here give:*

Freudenthal writes me that he must have had under observation in hospital and private practice "surely 20 cases or more." Unfortunately, he has no distinct records of them. But the percentage of permanent recoveries after intranasal operative treatment he reports as "none," and after external operations likewise as "none."

Otto Stein says that he must have seen between 12 and 20 cases of nasal sarcoma, which were treated by "various methods" with "varying results."

Thompson reports 12 cases, 9 of which were inoperable. Hence these 9, with Stein's 12 to 20, and Freudenthal's 20, are not tabulated in my present report.

Now and then, though rarely, a detailed report of a single case has been forwarded, which in itself is intensely interesting, giving at a glance a vivid picture of the whole scene. For instance, Freeman reports one that he referred to Keen for external operation. I quote his own words: "The sarcoma evidently began in the naso-antral wall and extended into the frontal sinus, antrum, ethmoid and sphenoid, by finger-like projections, but it did not seem to infiltrate the lining of these cavities, as it was easily shelled out, leaving them with the exception of the orbital plate and the naso-antral wall, practically uninjured. The incision was so extensive that the interior of all the accessory cavities on the affected side could be plainly examined. The septum was not involved, and after the operation, the eye was kept from falling into the antrum by packing. Although the operation was done eight or ten years ago, there has been no return."

Norval Pierce mentions six cases. All were treated by intranasal methods, although of what nature is not mentioned. All recurred but one, in which there was complete removal at a very early date. In this case the recovery was permanent. In two of the cases, external operations were subsequently done with only temporary benefit.

Chevalier Jackson reports eight cases. All were operated on by the external method. Two of these disappeared afterwards, so that no trace could be made of them. But the other six all died of recurrence of the disease at varying intervals after operation.

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*A number of reports have been received since the preparation of this paper, but too late for publication. The general tenor, was the same as in those already reported.

To be definite, the following is a summary of all cases reported as operated upon, whether internally or externally, in which the patients were kept under observation until final results were obtained:

No. of Cases.	R. Nas. C. Affected.	L. Nas. C. Affected.	Both C's Affected.	Sept. Affected.	Ant. Affected.	Int. Nas. Oper.	Recurrence.	Extra Nas. Oper.	Recurrence.	Deaths.
51	22	29	9	11	27	19	13	33	25	38

In several of the above, operations were done both intranasally and extranasally.

Permanent recovery after intranasal operations, 6 out of 19, or 31 per cent.

Permanent recoveries after extranasal operations, 8 out of 33, or 24 per cent.

Total permanent recoveries after operations of whatever kind, 13 out of 51, or 27 per cent.

We must add to these the inoperable cases and those refusing operations, which presumably would all be fatal.

In one point, the consensus of opinion among authors appears to be unanimous; and that is, in the absence of pain when the soft tissues are alone affected.

Before speaking of my personal experience in the treatment of this disease, I may say that I have drawn a wide distinction in my meaning between intranasal operations and extranasal operations, all classes of intranasal operations being included in the one, the work being done through the anterior naris only and without injury to it; and in the other, all classes of external operative work done by surgical incisions through the true skin, and by this means aiming at the removal of the sarcomatous growth.

Personally, I have have had four cases under treatment. Only one of them suffered from pain within the nasal cavity. The main signs and symptoms in all four were intranasal. All were males, their ages being 18, 20, 50 and 58 years. All were subject to severe epistaxis upon very slight provocation. With one exception, there was complete blockade of the affected nasal passage. By the process of exclusion, as well as by the signs and symptoms, the disease in three of the cases was pronounced to be sarcoma by competent medical authorities before the cases were referred to me for treatment; and in each of these, two or more distinct microscopic examinations verified that the diagnosis of sarcoma was correct. In the remaining case, histologic examinations were made at my request, and the case was pronounced a spindle-celled sarcoma. In this patient the growth was the smallest.

Although the results in my cases have been unusually favorable, I do not give any credit to the skill of the operator, but to the method of operating—and I emphasize the latter, because the work has been principally done by the use of that much-abused instrument, the electro-cautery knife.

The first three cases were reported in the August number of the *Journal of Laryngology* in 1903. At that time eight years had elapsed since the final operation upon the first case. The case was well then, and is well now, with no recurrence whatever of the disease.

In the second case, and this was of the spindle-celled variety, already referred to, occurring in a man, aged 50, the growth had been removed about a year when the case was reported. At the present time, three years later, he is still a healthy man, following his daily occupation as fireman, and free from any redevelopment of sarcoma.

The third case was the most extensive purely intranasal sarcoma that I ever saw, filling the left nasal cavity, bulging the anterior naris, flattening the nose and cheek, more than half filling the nasopharyngeal space and holding the soft palate immovably in a horizontal position. This case was referred to me in October, 1902, now four years ago; and was reported by me with the exhibition of pathologic specimens and micro-photographs at the meeting of the American Laryngological Association at Washington the following year. As, however, it was considered rather premature to report so recent a case, I again read a paper upon it, reporting progress, at the annual meeting of the same association at Atlantic City in 1905. I furthermore exhibited the patient himself, this time at the laryngological section of the British Medical Association in Toronto in August, 1906. There have been slight recurrences, at the junction of the posterior naris with the nasopharyngeal vault, up to February last; but they were always controlled by a touch of the cautery. The man is well nourished and presents a rugged and healthy appearance. The nasal cavity is wide and free throughout its whole extent, exhibiting in some measure the great size which the growth had assumed before its removal. When required, he keeps the passage free from accumulations by the use of an oleaginous spray. His occupation is that of telegraph operator, in which he is regularly employed. He learned the art since the removal of the sarcoma four years ago.

These cases were all treated by intranasal electro-cautery operations, the parts being anesthetized by cocain. The first one, operated upon eleven years ago, was treated before the advent of adrenalin, and was attended by some terrific hemorrhages. Still the work went on with the result adready stated. In the second and the third, adrenalin was used freely and with marked advantage. In the third, however, the hemorrhages were often exceedingly severe, possibly in some instances due to a desire to remove too much at one sitting. These three men are all well, busily following their occupations in Toronto to-day.

In all these cases I believe that the growth was mainly if not entirely confined to the nasal cavity. The method of operating, particularly in the third case, was as follows:

After producing local anesthesia and anemia by the free use of cocain and adrenalin, a large tubular speculum was introduced into the nasal passage as deeply as possible; and then perpendicular incisions with the electro-cautery knife at a high degree of temperature, were made into the basal attachment of the growth on the turbinal side. They were made as deeply as possible without producing alarming hemorrhage. The moment this threatened to be severe, the operation ceased, and temporary tampons would be inserted to control the bleeding; but almost invariably these would be removed before the patient left the office.

On his return, one or two days later, the cauterized tissue would be removed either by snare or forceps, and the parts cleansed by sprays. Then anesthesia and anemia would again be induced and the operation repeated. Thus, successively, piece by piece, and day by day, with the electro-cautery blade at almost a white heat, the sarcomatous tissue would be dissected away, working gradually from before backwards, until the posterior naris would be reached; and the patient, to his delight, would be able to blow his nose through a free passage again—something he had not done before for months, perhaps for years.

Case IV.—This, my most recent case, was referred by Drs. Carleton and Langstaff.

On August 2, 1906, the patient, a retired butcher, aged 58 years, was first seen by me. Pathologic section had already been excised and microscopically examined, and the case was pronounced one of malignant disease.

I found on examination that the left nasal cavity was filled completely from the anterior to the posterior naris with a dark red growth, dense in character, but which bled readily on being touched. I removed a section, and microscopic examination proved it to be a round-celled sarcoma.

Family History.—His father had died at the age of seventy-two years, presumably of some cerebral trouble, but on post-mortem examination, his family physician had found a hard cancer of the stomach.

Personal History.—A number of years ago, small growths, presumably polypi, had been removed from time to time from the nose; and latterly, while otherwise healthy, he had been troubled with a good deal of yellow discharge from the left nostril. This was supposed to arise from left antral disease. During the present year the left nostril had gradually closed up by the formation of the new growth; and as the cavity filled the discharge lessened. For six weeks there had been practically no discharge, but an external swelling had formed over the left nasal bone in the region of the lachrymal sac. This had been opened with a lance, giving exit to a free discharge of pus, particularly on pressure. Accumulation recurring, relief was given from time to time until I saw him—the conclusion being that the external discharge of pus was really a vicarious outlet from the closed antral cavity.

There was no particular external enlargement, but there was oppressive headache and some soreness of the nasal region. The temperature varied from 90° to 101°. Mouth breathing was compulsory, and there was a severe odor of antral disease. He had lost twenty-five pounds in weight during the last four months. The corresponding cheek was not swollen, but there was eversion of the lower eyelid, which the patient affirmed had existed for years, and was due, he said, to severe exposure during a winter storm.

After careful examination, I arrived at the conclusion that the attachment was probably to the outer wall, and that while the middle and the inferior turbinals were involved, the vault and septum might be free; and that if the antrum was affected, it would be near the middle of the nasoantral wall.

I believed also from my past experience, notwithstanding the age of the patient, that I would be justified in operating upon similar lines. To this the patient gladly assented; although at the same time, I told him of the risks of the operation, and the possibilities of non-success and recurrence of the growth.

For each operation upon the growth the patient came a mile and a half on the street cars, walked into my office, walked out again, and returned in the same way.

August 7th. After applying cocain 8 per cent and adrenalin 1 in 1000, the first operation was done as already described, the cuts being made with the electro-cautery knife at a bright red heat. The tissue was dense and hard to penetrate, but the bleeding was slight, care being taken not to cut in too deeply on this tentative occasion. Pain also was slight. Of faintness, there was none. No tampons were inserted.

August 8th. Returned to office, sloughs removed. Operation repeated.

August 9th. Exactly similar treatment with operation.

August 10th. Also similar to the previous occasion with operation.

By these four operations, the tumor, which had filled the left nasal cavity almost to the tip of the nose, had been dissected back for more than an inch, leaving the vault, septum and floor clean. On the outer wall, the front parts of the middle and inferior turbinals, which had been softened in character by the development of the disease, had been dissected away, without any appearance of recrudescence.

As I was leaving the city for a few days, the man returned to his own home, sixteen miles away, during my absence.

August 20th. Under exactly similar conditions to those already mentioned, he again came for treatment; and electro-cautery operations were done under cocain and adrenalin anesthesia as before, on August 20, 21, 22 and 23. The sloughs were taken away on the day following each operation before renewing the burning. By this time the greater part of the middle and inferior turbinals had been removed and the patient could force air pretty freely straight through the passage. Of course, together with the removal of the sloughs daily, the cavity was freely sprayed out with an alkaline solution, washing away the debris as well as the pus, which found freer outlet from the antrum.

August 25th. On this day the last electro-cautery operation was done, burning away, so far as could be seen, the last remnants of sarcomatous tissue. The lower turbinal was entirely gone, and a large part of the middle turbinal as well. The nasoantral wall was still intact. The movements of the soft palate could be easily observed through the nasal passage, and the patient could blow out that side of the nose with much greater freedom than he could the well side.

For several days the passage was freely sprayed, and as pus was still constantly oozing from the ostium, chloroform was administered to him on August 28 at the Western Hospital, and I opened the antrum through the central part of the inferior meatus. Here the bone was soft and easily penetrated. A wide opening was made, but anterior and posterior to the site of operation the bone seemed to be of normal density. Probably at this point the osseous tissue was involved in the disease. The operation was attended with very little hemorrhage. Pus mingled with blood and some sloughing tissue were washed out and then the antrum was swabbed with peroxid of hydrogen.

After this date no further operative treatment of any kind was required. The antrum was washed out once a day with warm sterilized water, and for some days this was followed by the application again of the peroxid. Then the latter was discontinued as the condition improved. Still the nose was regularly sprayed two or three times a day with Dobelle's solution.

As the operations were comparatively painless, with little loss of blood, the cauterizations being confined to the line of sarcomatous attachment—the depressive effect of the operative treatment was slight; and for a couple of weeks subsequently, the patient seemed to rally. Then a species of malaise set in, accompanied by rise of temperature, with furred tongue, tympanites and many of the symptoms of typhoid.

The operations being over, he returned home to the care of his family physician; and as the discharge from the antrum steadily decreased, the intervals between the washings were made longer. From this time I saw him through the kindness of his physician once a week and personally washed out the antrum. Five weeks after opening the antrum it was washed out for the last time, as pus had disappeared. There were no sloughs and the water came out of the ostium of a clear, pale, straw color. There was also no return of sarcomatous tissue —the passage being perfectly free from anterior to posterior naris.

In one way I was disappointed. The extranasal pus cavity, notwithstanding the regular antiseptic treatment it received, did not close up after the free opening of the antrum, and careful exploration by the probe failed to discover any connection between the two. Still the discharge from the external cavity gradually diminished under treatment, although it did not disappear.

When I last saw the patient, in consultation with Dr. Langstraff, seven weeks after opening the sinus, the nasal condition was the same, but he was suffering from low delirium, sordes round the teeth, and dark, heavily furred tongue. There was some effusion within the abdomen and extremities, although examination of urine showed no trace of albumin. All fever had subsided.

It seemed to be clearly a case of septic infection, possibly from absorption of ptomaines from the sarcoma, possibly from the long continued presence of pus in the antrum and facial cavity, or from both combined.

The patient died one week later, seemingly not of sarcoma, as there was no visible sarcoma present, but of sarcomatous septic infection.

Fatal although the result may be, I believe the operations as done upon this patient were both justifiable and advisable; inasmuch as while the suffering from the operations was slight, the gain in comfort to himself and friends was of a very marked character. The distressing respiration disappeared, the fullness and pressure in the face was relieved, and the progressive deformity of the nose ceased to exist. All these would have been severely and continually aggravated, while life lasted, if relief had not been obtained.

Further still, from my experience in the former cases, as well as in this one, inasmuch as the growth seemed to be entirely removed, I feel confident that the intranasal operation has given greater freedom and comfort to the patient than would have been probable by external operative treatment; and the disastrous results attending the latter in advanced cases are so great, that I would not advise it in a case like this.

The advantages of intranasal operations over extranasal operations, in nasal sarcoma, in cases in which the large bones of the face are not involved, are very marked indeed; while unfortunately, the methods that can be successfully used are very limited. Of my four cases, not one was a pedunculated sarcoma when referred to me for examination. The nearest was the second case, but even in this one, the base was as broad as the growth itself. It is impossible to snare these widely attached sessile growths away. And when we try, our earliest reward is more likely to be an alarming hemorrhage than anything else. I well remember such a result in my first attempt at operation in my third case. After applying cocain and adrenalin freely, I passed a snare along the floor of the nose in the hope of grasping and removing a good sized segment to begin with. For a moment I was delighted with a successful result. A smooth oval piece of the growth as large as a pigeon's egg dropped into the bowl. For some minutes I could not examine it, as the hemorrhage was enormous, and required vigorous and tight packing to check it. When, however, I could take a look at my pathologic prize, it proved to be a large piece of gauze, which at some former time had been inserted in the nose of the patient to check a bleeding, and which had not been removed.

Neither can these large sessile growths be cut out of the nose by means of knife or scissors. When small and pedunculated no doubt they can. But as sarcoma of the nose in its early stage is painless, these cases rarely come into the hands of the specialist until they are well developed and have lost their pedunculated form. The base of the growth becomes widely sessile; and it would be simply impossible to dissect out through the narrow naris, such a hemorrhagic tumor as a sarcoma with attachment along the whole of one side of the nasal cavity from the anterior to the posterior choana.

Possibly it is for this reason that so many of these cases are referred to the general surgeon for external operation, while it would be much better, cosmetically and in every other way, for the patient, if the rhinologist could remove the growth intranasally.

We are living in an age of brilliant operative surgery, in which the clean cut, done once and for all, is considered the operation par excellence. And it is only natural that the laryngologist should be willing and desirous to emulate his surgical brother in the accuracy and finish and finality of his work—alas for the patient, the finality is sure enough in nasal sarcoma. Leaving out the 20 cases reported in the one instance as all fatal, and the others that either disappeared or were inoperable in the list already given, there were only 13 permanent recoveries out of the remaining 51 cases—27 per cent. I fear this is the worst report that has yet been published; but I have the record over the signatures of the men who so kindly and promptly answered my questions—and all honor to them for doing so.

Granting then that the external surgical operation rarely results in permanent cure; and that internal operation, neither by knife, nor snare, nor scissors, nor curette, nor all combined, can remove successfully a large sarcoma having an extensive basic attachment; why not accept the electro-cautery knife as the instrument of excision, when by its judicious and patient and regularly repeated use, the work can be successfully and safely accomplished, for the time at least? Not only can this be done; but by the removal of the sarcoma in this way, we have the additional advantage, over an external operation, of retaining a wide patulous nasal cavity, through which the growth can again be attacked and destroyed if recurrence should take place.

The claim I make is, that inasmuch as a large majority of the cases of nasal sarcoma originate in the soft tissues of the nose—even Freeman's case described so graphically, illustrates this point—they can at any time be operated upon with the electro-cautery, provided the bony framework of the nose has not become affected with the disease. That in many of these cases a cure can be accomplished by thorough and careful and painstaking treatment; and that even in cases usually considered inoperable, great and beneficial relief can in some cases be secured to the patient by the same means.

LXXXVII.

TWO CASES OF STAMMERING, ILLUSTRATING THE IMPORTANCE OF EARLY TREATMENT.*

By G. Hudson-Makuen, M. D.,

PROFESSOR OF DEFECTS OF SPEECH IN THE PHILADELPHIA POLYCLINIC HOSPITAL AND COLLEGE FOR GRADUATES IN MEDICINE.

At a recent section meeting of this society, in Syracuse, I had the pleasure of outlining a plan of treatment for stammering, and I now desire merely, as a supplement to that paper, to report two cases, illustrating the results of the treatment, one of which was successful and the other only partially so. I desire also to point out that the comparative failure in the one case was due, among other things, to the fact that the habit had become more deeply rooted, and that as a consequence there had arisen in the mind of the patient an almost ineradicable idea which seemed to be directly opposed to normal speech. This idea had the fixedness of those often found in hysteria, and it was strongly suggestive of that disease.

The patient was 10 years of age. His elder brother stammered, and several other children in the family had some lesser peculiarity of speech. He had had measles, croup, whooping-cough and bronchitis. Adenoids were removed in infancy by Dr. T. H. Halsted. He still takes cold easily, and has some catarrhal droppings in the throat. There is a history of consumption on the mother's side, and he inherits a nervous disposition. He is bright intellectually, but abulic and amnestic. He cannot will to do things, and he forgets. He is specially lacking in the control of his muscles, and the development of the kinesthetic memories for their action and co-ordination in speech, is extremely slow. His favorite expression is "I don't know," and he is never unable to say it. When called upon to recite something voluntarily, however, he grows pale and loses control of his voice entirely. He has been under treatment for a little more than two months, and although the improvement is very great, many more months may be required to complete a cure.

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*Read before the American Laryngological, Rhinological and Otological Society, at Kansas City, Mo., June 12, 1906.

The other one is the son of a physician in Pennsylvania. He was two and a third years of age when brought to me by his father and mother. He began to talk very early, and he was developing a severe form of stammering. He was also of a nervous disposition, but I could elicit no history of a similar affection in either his immediate or remote ancestry. He had been for a single day with a child that stammered very badly, and thus may have caught the affection. In the course of a half hour's conversation with the father, a plan of home treatment was suggested which resulted in a complete cure of the stammering, and the entire removal of the vicious tendency in a very short time. On May 11th, thirteen months after my first consultation, I received the following letter from his father, Dr. L. S. Walton: "Dear Dr. Makuen: I would say in regard to my little boy, that when he began to talk he stammered so badly that it was impossible to understand him. At times he would clasp his hand over his mouth and say, 'Cannot talk.' After consulting you, I began at once to follow your instructions. We noticed an improvement in a very short time, and at the end of four months, very much to our relief, he was entirely cured. One year has passed, and he now talks fluently. Please accept my sincere thanks, etc."

A question often arises, "What is the best time to begin the treatment of stammering?" and I have said somewhere, that the best time to cure stammering is before it begins, and that if all children showing a tendency to the affection could have the proper management at the very beginning, the great majority of them would never acquire the pernicious and distressing habit.

The two cases above reported seem to present good illustrations of this fact. The first patient had acquired the habit of stammering, and having inherited a nervous temperament, he presented unusual complications, while in the second no such psychic conditions were present. There was only the beginning of a disturbance in the centers of co-ordination. The child was beginning to evolve ideas more rapidly than he could express them. His attempts at speaking were similar in all respects to water gurgling out of a small bottle. His words were literally tumbling over one another, and he only required a little help in the co-ordination of the processes of the manufacture and the delivery of them.

The home treatment for beginners in stammering is one that may be carried out by any intelligent parent. The child is always of the so-called nervous temperament, and he usually inherits some peculiarity of speech. If it is not found among his immediate ancestors it may often be traced to a former generation. It may not be sufficiently marked as to amount to actual stammering. It is often only a very blustering form of speech. In tracing the cause in individual cases of stammering, it is not an unusual thing to find the father or mother to be a very rapid talker. Thus the question of imitation comes in and complicates that of inheritance. The two factors combine in many instances as if to make sure of their victim. The child inherits a tendency to faulty speech; he hears faulty speech about him, and, speech being acquired solely by imitation, his only recourse seems to be to hesitate, and finally to stammer.

The diet for such children should be simple and nutritious. The patient should spend from a half to three-quarters of every twenty-four hours in bed. All disturbing influences and exciting amusements should be interdicted. Under no circumstances should any kind of talking be allowed during periods of emotional excitement. A systematic course of calisthenics should be instituted, and especially those free movements that tend to develop the respiratory organs. Breathing exercises should form a vart of this course, and the child should be drilled in the proper methods of forced expirations, such as are used in crying, laughing, hallooing. The diaphragm and abdominal muscles should be trained to perform their part in vocalization, and for this purpose, phonetic and syllabic speech should be practiced.

LXXXVIII.

VIOLENT EPISTAXIS IN A GOUTY PATIENT.*

By Prof. A. Trifiletti,

NAPLES.

Among the numerous and varied relations of spontaneous epistaxis to certain general morbid conditions, that to the arthritic diathesis or its gouty manifestations has already been brought out by writers, but perhaps too indefinitely.

I am permitted to report the history of a case of this sort recently observed, in which this relationship appears to me to be positive.

The patient was a woman, aged 50 years or thereabout, obese, anemic and at the same time rheumatic or susceptible to rheumatism of a maximum degree. She led a sedentary life at home, complaining almost continually of pain and suffering in various parts of the body, but especially in the region of the tarsal and metatarsal, phalangeal and metaçarpal articulations, etc., which at present are a little enlarged and painful and covered with edematous skin, but without any true gouty deposits.

The patient, in spite of her age and her adipose and anemic state, still had her menses, which, however, were rather abundant, there being nearly always a metrorrhagia. Her father, aged about 80, is still well. Her mother died recently but without any arthritic diathesis. There is no other hereditary complaint. In fact, the patient had not suffered from anything else than malaria, having lived in her youth in a swampy place, but the chills had not recurred. She has been subject to slight attacks of bronchial catarrh, of which she still has signs.

It was during one of these attacks on the evening of April 9th last, that the patient began to bleed violently from the left naris. Her menses, then in progress, stopped. The epistaxis, with varying severity, in spite of the hemostatic means employed, persisted all night, and next morning the local physicians did the classic antero-posterior tamponnement of the nasal fossa, with much discomfort to the patient. Nevertheless, at varying intervals there were renewed hemorrhages from the fossa, escaping through either the anterior or posterior tampon, or even the naris of the opposite side (right). The patient felt prodromes of the hemorrhages; she had formication of the skin, blood rushed to her head, her feet became cold, and then the flow began.

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*Translated by Albert Miller, A. B., M. D.

This continued for four or five days, making the patient more and more anemic, when I was called to see her and to suggest a more effective remedy for the epistaxis.

Having learned the history, and the somatic conditions of the patient, and that the tampon was well in place, I thought that the latter was insufficient in view of the violence of the hemorrhage (aside from its intolerance, which I thought could be remedied by tamponing with a long strip of iodoform gauze, as is done by rhinologists). However, I did not wish to advance any definite opinion before a local observation, so I took advantage of a temporary cessation of the blood flow to remove the tampons and clots.

The result of my examination and the course of the case for about 24 hours are as follows:

Rhinoscopy showed much congestion of the Schneiderian membrane, especially on the left side, increased by the presence of clots. Nasal cavities large, as in atrophic rhinitis, permitting a view of the posterior wall of the pharynx, which was similarly congested but free of morbid products. There was an absence of pathologic secretions, varicosities and circumscribed swellings, etc. The mucosa bled easily, especially upon the septum and floor, even simply by wiping or passing the cotton carrier over it with a view of discovering the bleeding point or points. However, I could not distinguish any, for entire portions of the mucosa bled *en bloc* (hemorrhage *a nappe*). The pharyngeal vault vault remained clear.

As to the clinical course of the epistaxis, I noted plainly that it was of a recurrent form with attacks occurring every 3 to 6 hours or longer (once the patient had gone without a tampon an entire night). The attacks were always copious, violent, and difficult to stop.

As to the utility of tamponing with iodoform gauze, which I prefer (aside from its tolerance, asepticity, etc.), it must be confessed that in some exceptional cases, such as the present, it is not better than the classic tamponade.

It is to be remarked here that when the tampon was tight in front the blood flowed out posteriorly, and vice versa, which unequivocally shows the origin of the epistaxis in this case. Fortunately, little by little, the hemorrhagic tendency began to decline spontaneously, and then any means, including adrenalin, etc., appeared to be very good for the purpose.

The epistaxis, then, was not fully explained by local conditions except as a *locus minoris resistentiae*. It is also true that from the beginning it was very copious and sudden.

Now, this brings us to another part of our research, not the bronchial catarrh which was rather a small matter, nor the spleen which was almost normal (this with regard to a latent malaria with epistaxis), nor the cardio-vascular examination, which showed simply a slight arterio-sclerosis,* but the dyscrasia, as shown by an examination of the urine. This was done by Prof. V. Gianturco, April 19, 1906, and gave the following result:

Physical Character.—Slightly cloudy, yellow amber color, acid reaction, specific gravity 1025.

Microscopic and Bacteriologic Examination.—The residue upon the filter, examined microscopically, showed: Several mucus corpuscles, very numerous pavement epithelial cells, a few decolorized red corpuscles, several particles of urate of soda, a few crystals of calcium oxalate, a few waxy casts and some cylindroids.

Normal Pathologic and Accidental Chemical Constituents.—Of the normal constituents, the urea (gr. 29 per litre), the urates, the oxalates and the alkaline and earthy phosphates are increased slightly. Indoxyl and skatoxyl sulphate are trebled in proportion. The other normal constituents, such as creatinin, oxaluric bases, pigments, sulphates and chlorides, are in usual amount. Albumin in small traces, not over 5 centigrams per litre. Absence of sugar and every other pathologic constituent.

In contrast, notice the following analysis, made August 15,

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*These observations have been confirmed by different clinicians who visited the patient after myself, especially Prof. G. Bolucci, who insisted upon the possibility of gouty kidney, which will be discussed further on.

1906, four months after the attack: Urine slightly cloudy, pale yellow color, acid reaction, specific gravity lowered to 1018. Several mucus corpuscles and epithelial cells, mostly pavement. No casts visible. Of the normal constituents, the indoxyl and skatoxyl sulphates have quadrupled; oxalates slightly increased. The other normal elements, such as urea (grs. 19 to the litre) are in usual proportion. Albumin persists as a trace.

REMARKS.

In these urine examinations (although the first was made on the tenth day of the epistaxis, the patient being on milk diet) every clinician will read the uric acid diathesis and the possibility of gouty kidney.

Without going into the details of these diseases, which would lead us into foreign fields, I cannot avoid associating the foreign epistaxis of this patient with the arthritic, or more properly uremic, attack. Considering the patient as gouty, we must admit the possibility of various vasomotor troubles and unwonted vascular pressure, hence the hemorrhage. From this viewpoint, we could also link the epistaxis with vascular disorders inherent to the menopause, and speak of it as a vicarious epistaxis, or, according to some writers, neuropathic (Türck).

But my first conception was confirmed by the following circumstance: Hardly had the tendency to epitaxis disappeared, 17 to 20 days afterward, when the patient was attacked first in the fingers of the left hand and then in the arm, with severe pains accompanied by edema of the skin. These were not relieved by general or local treatment, but ceased spontaneously in about 20 days, without any febrile movement to note, or any suppuration.

This should be interpreted as a true arthritic attack, or anomalous gout, which throws light upon the preceding epistaxis.

In conclusion, I have not pretended to advance a new cause for spontaneous epistaxis—still less to affirm that here the epistaxis was a gouty manifestation—but have simply desired to clear up the bond, already admitted by writers, existing between epistaxis and certain diathetic states.

LXXXIX.

THE IMPORTANCE OF DISEASES OF THE NOSE IN TREATMENT OF THE SO-CALLED SCROFULOUS DISEASES OF THE EYE.*

By Dr. C. Ziem,

DANZIG.

Many diseases previously known as scrofulous are now ascribed to tuberculosis, especially those ocular diseases of children characterized by a supposedly essential stubbornness and lasting for years, such as diseases of the lid margins, conjunctiva, cornea and sclera and, according to many authors, even of the iris. Yet the progress achieved in ophthalmology by this shift is not great, since the localization of tubercular virus or bacilli in the eye is very seldom established, but the patients after they have been treated by proper local and general treatment, which need not always nor even occasionally be antitubercular, for years and even decades, remain free from any fresh scrofular, tubercular or pseudotubercular disease of the eye. A much larger number of "scrofular" diseases of the eye must rather be considered due to:

(1) Malaria, a very characteristic example of which can be quoted from the fourteenth century, in the Decameron of Boccaccio, a writer of rare medical knowledge. In the description of the maid Ciuta (VIII, 4) are the words: "ella aveva il naso schiacciato forte e la bossa torta e le labbia grosse e i denta mal composti e grandi e sentiva del guercio, ne mai era senza mal d'occhi, con un color verde e giallo, che pareva che non a Fiesole ma a Sinigaglia avesse fatta la state: e oltro a tutto questo sciancata et un poco monca del lato destro,"[1] * * * * to which the publisher, Fanfani, adds the statement that Fiesole lies on a mountain with very

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*Translated by Clarence Loeb, A. M., M. D.

pure air, while Sinigaglia lies in una regione di ara malsana (in a region where the air is unhealthy.)[2]

(2) A disease similar to malaria, accompanied by hypertrophy of the spleen (Herm Weber, Gerhardt, Friedreich, Oppenheimer, etc.), which is caused by the influence of gloomy cellars, the moisture from damp floors of rooms, modern wall fillings, etc., and is very frequent in houses built on swampy ground, such as is the case in Danzig.

(3) Influenza, measles, scarlatina, chicken-pox and other infectious diseases which appear first on the mucous membrane of the nose and are accompanied by fever and pus formation. These diseases extend from the nose—

(a) Upwards, either by continuity along the mucous membrane, the nasal duct and conjunctiva, or through the blood and lymph vessels to the eye;

(b) Downwards to the larynx and lungs, giving rise to chronic destructive diseases or localization of the bacilli themselves (Piorry, Alexander, etc.); or

(c) In other corresponding directions, leading to suppuration of the middle ear, hypertrophy of the lips, eczema of the cheeks, pseudoscrofular hypertrophy of the submaxillary lymph nodes (Velpeau, Griesinger, v. Tröltseh[3]), while such a hypertrophy in other cases is usually caused by diseases of the teeth, according to Stark, Partsch, Hans Körner, etc.

The relationship of the primary disease of the nose with the secondary disease of the eye, or as Schmiegelow[4] puts it, "the rhinogenic nature of many diseases of the eye, especially the 'scrofular'" was more or less well known by older authors, not specialists in the narrow sense of the word, such as G. A. Richter, J. v. Hasner, Vésigné, Gensoul, W. Roser, Zehender, Horner, Ed. Meyer, Adolf Weber, etc. Especially the later view, that "scrofular" eczema of the cheek may cause disease of the eye by the transference of purulent secretion by means of the finger, does not hold good, in addition to other reasons, because it can be proven that adults with febrile eczema of the cheeks and scalp and purulent catarrh of the eyes and nose do not acquire the eye disease in this way, and because a cure can be obtained in a short time by proper treatment of the eyes and nose and correct general treatment, without any local treatment of the cheeks themselves.

The ophthalmology of the present fails in the case of these diseases—

A. On account of too energetic local treatment of the nose.

B. On account of neglecting a systematic treatment of the nose, nasopharynx and pharynx.

C. On account of neglect of fever which is often present.

A.—I believe that the first thing to be done in scrofular disease of the eye, in order to bring about the most favorable conditions of curing, is the regular cleansing of the nose by means of large amounts of a nonirritating fluid, i. e., physiologic salt solution, and a lavage of the conjunctival sac by means of a de Wecker power irrigator, or, better still, is the continuous stream of an air-tight force pump, because, according to my published experiments,[5] it is more active and quicker and more easily regulated as to pressure in cases of corneal ulcers, etc. An interrupted, jerky stream is very unpleasant on the eye and, as seen lately by me in a well observed case, it may cause disturbances in the functions of the retina by its blows. Even children of 5 years can be easily treated, especially after demonstration on some other child; those still younger are held on the mother's lap or an operating table with the head turned somewhat to the right or left. This lavage is very important in the frequent dust conjunctivitis or keratitis caused by fine dust, glass dust, sawdust and especially sand in forestless or deforested places with frequent sand storms, such as East Prussia, near Marsailles, the highlands of Spain, South Russia, Hungary, Egypt, South Africa, etc. If the fine dust granules remain in the sac, they may cause distinct trachoma-like swelling of the conjunctiva, often considered "scrofular," occasionally only of one upper lid, or vascular and even purulent keratitis, a very distinct case of which I reported six years ago[6]. Cold applications are often injurious to diseased eyes, often calling forth a nasal catarrh when it is not already present; lukewarm applications are better in conjunctivitis, and warm applications are indicated in single and purulent iritis. Atropin, which Adolf Weber discarded in 1877 for corneal ulcers, is indicated only in iritis, but even then, in fever following influenza, is often injurious, probably by preventing the very important secretion of sweat[7]. Among the few patients whose eyes became worse while under my treatment, I must always rank two persons who suffered from influenza and hypopyon keratitis, and who after repeated instillations of atropin, rapidly became worse, one eye, or rather both eyes, being lost. In spite of the opinion of Horner and others who agree with him, I agree with Professor Hess[8], of Würzburg, that atropin is not indicated in photophobia following scrofular keratitis, and has been discarded in ulcers of the cornea by veterinary ophthalmologists on account of the permanent scar.[9] The yellow salve which is so frequently used for dust conjunctivitis, and which is considered almost a panacea, but concerning whose healing powers Professor Hess seems to have some doubts, has not been used by me in my practice for more than twenty years. Frequent slitting and probing of the tear passages, opposed thirteen years ago by Terson of Toulouse, and later by different Italian writers, especially Guaita, Cirincione and Fumagelli,[10] is actually very seldom necessary when the nose is correctly treated. J. Hirschberg has recently reported several cases of concretions in the canaliculi or of atresia of the ostium nasale treated without benefit where probing or perforation from the nose was not to be recommended: e. g., W.—Lachrymation on both sides, slitting the canaliculi by Dr. N. Probing, no result. Sewed together by Dr. N. N. Conjunctival instillations, no result. Lavage of the eye and the catarrhal nose with salt water by me, complete cure since the fall of 1904. Even the injection of plain water through the canaliculus, which Zehender claims will cure nineteen out of twenty of all acute cases,[11] is unnecessary in the great majority of cases when the nose is correctly treated, sometimes only syringing of the nose with saline solution being necessary. I, myself, before the opening of my purulent right antrum in 1883 suffered from epiphora of the right side; since then, spontaneous cure. The same thing happened in a case described by me in 1886[12]. Of course, every case of dacryocystitis is not accompanied by a suppuration of the corresponding antrum, although Kuhnt found them so often together that he advises, and with perfect right, that the most careful search be made for a maxillary empyema in such cases[13]. In 1895, however, I reported a case where there were distinct bulging of the tear sac, suppuration of the nose, absence of the corresponding first upper molar, complete darkness of the maxillary region in transillumination and complete absence of any subjective sensation of light, and yet, when the antrum was opened through the alveolar process and syringed, no suppuration of the sinus was present[14]. On account of the close vicinity of the antrum to the nasal duct, which is well shown in the drawings of frontal, horizontal and sagittal sections of the head by Sömmering[15], Henle[16], Merkel[17], B. Fraenkel[18], Zuckerkandl[19], Spalteholz[20] and Toldt[21], the extension of a suppuration of the sinus to the ductus lacrymalis is easily possible, even without the presence of a true fistula, a fistula duct. lacrym. intern., which F. v. Hasner[22] observed on a cadaver in 1850, in a medullary sarcoma of the sinus, and which seemed to be present in a case of empyema of the antrum, reported in 1885 by J. v. Michel[23], where, on blowing the nose, the whole conjunctival sac was flooded with pus. Of course, it would have been better to confirm the diagnosis by injecting a colored fluid into the sinus, since in a case, observed by me, of abscess of the orbit and fistula of the tear sac accompanying empyema of the antrum, the venous stasis caused by the pressure forced pus not out of the antrum but out of the orbit.[24] Participation of the ductus and saccus lacrymalis in suppuration of the frontal sinus was seen only once by Kuhnt[25] up to 1895, yet a case of that kind, an "ozena a tipo frontal-ethmoidale anteriore, una vera miniera di insegnamenti etiologici patologici e terapeutici," was reported at length from the clinic of Toti[26]. In acute dacryocystitis, in addition to proper treatment of the nose, there is to be used local warmth, or something which has been used by me for years in abscesses and diseases of bones elsewhere in the body, and which has lately been recommended by others, viz., a vesicatory, e. g., emplastr. camph. fusc. extens., whereupon the swelling frequently disappears of itself. Otherwise, incision and expression of the abscess and application of a plaster, which is perforated in many places and frequently renewed for aiding the evacuation of the abscess are necessary. But why the extirpation of the tear sac in relapses, which in the practice of many has run into thousands and has even become a kind of sport, whereas the cause apparently lies in the nose, which, in most cases, has not been examined: e. g., there is the case of severe suppuration of the nose seen by me ten years ago, where someone had extirpated the tear sac without affecting the epiphora, whereas, in the case of the tube-maker B, of this place, after someone had proposed extirpation of the tear sac, regular lavage of the nose and conjunctival sac, carried out for weeks, and application of leeches in the retrolobular region, had relieved the purulent dacryocystitis to such an extent that the number of times the eyes had to be wiped had been reduced from once every half hour to once a day. Then there is the case of the dock-hand B, who formerly had to empty his purulent tear sac every five minutes, but who, because of similar treatment, has been completely cured for three years. Similar results are to be obtained in many cases, even without extirpation of the tear sac, without the treatment recommended by Gatteschi,[28] viz., removal of the middle turbinate with curetting of the ethmoid, or without the method frequently used by Wolhouse, which extends all the way back to Galen[29], and which has been used in an improved form by Toti[30], viz., the formation of a tear sac-nasal fistula (dacryocystotomy) or Laugier's tear sac-antrum fistula, in regard to which Hyatt has remarked that it was not clear how the hole in the bone was to be kept open long enough.[31] Now, in the twenty-five patients operated on by Toti, where in addition to the lachrymal bone the inner half of the lachrymal sac was removed, a cicatrization of the fistula has so far taken place only in one, case 7, a child of 5 years. Perhaps, on longer observation, this will take place in other cases also, for of the twenty-five cases, four were not over 6 years old, nine not over 10 years, thirteen not over 15 and sixteen not over 18 years, whereas the power of regeneration still exists. Callus formation in so young an age is naturally very extensive. Otherwise, it cannot be denied that Toti's results were very rapid; still a careful treatment of the nose, as noted above, combined with a thorough blood-letting from the lower turbinate, would have made a more extensive operation in a number of these cases unnecessary. Furthermore, in several cases, especially 1 and 2, Toti ordered "abbondanti lavaggi nasali per la forma ozenatosa" of the disease. At least, the author has the credit of preventing unnecessary extirpation of the tear sac from without, and of devising for severe cases a rhinosurgical method which is at least sometimes effectual.

Away with the scharp curettes which Möller[32] has discarded even for animals (dogs), and the galvanocautery in ulcers of the cornea, even the ulcus serpens with or without hypopyon, which is so often found with "scrofular" nasal suppuration, and which probably has a febrile origin and should be so treated; e. g., P. ulcus serpens, purulent nasal catarh, influenza; February 22, 1904, vision=4/24; lavage of eye and nose, warmth, dressing, fever treatment (v. later), ambulatory treatment; February 17, 1905, vision=4/9. Away with the unnecessary and even harmful iridectomy, so often seen by me in the practice of others, for central scar of the cornea, for the vision in such cases can be increased in a much simpler way, e. g., as in the following case: B, 40 years old, treated more than twenty years before for scrofular keratitis, had a central scar of the cornea and a vision of only 4/24 on October 9, 1904, but after two lavages of the nose and applications of two leeches to the postauricular region, the vision on October 20 was 4/12, naturally not because of any clearing up of the old scar, but rather because of curing of a hyperemia of the choroid, which had probably existed for some time and which was secondary to a nasal condition. In orbital or paraorbital abscesses, attention to nose and teeth is strangely neglected, as I lately saw in a 5-year-old girl, who suffered from fever after influenza, and from suppuration of the nose, and who had been treated by a specialist only by daily expression of the abscess, but whom I quickly cured.

Even the rhinogenic nature, so often apparent, of osteitis orbitalis was not mentioned by Schmidt Rimpler[33] last year, in spite of the articles of Ziem,[34] Panas (1894), and others, and yet more can be accomplished in such cases, especially when the abscess is deep, by local vesicatory plasters, sojourn in a garden or forest and treatment of the nose, than by too early incision and a depleting bleeding. Away, also, with the heating flannel bandage, very much in evidence in Danzig ten years ago, which is useful even in policlinic treatment only in severe cold, and substitute the light gauze bandage, which can be removed at night in most diseases of the eye, even in many traumata.

B.—Treatment of the Nose.

In spite of the present view of many, lavage of the nose with physiologic salt solution by an air-tight pump is of great importance in many diseases. The entrance of the water with its mucus or pus contents into the middle ear, so much feared, takes place only when (a) water is forced into the ear by a pump or syringe which does not give a continual stream, and (b) when a counter-opening is present, i. e., a perforation of the drum, through which the air in the middle ear is forced out. When Lichtwitz[35] states that O. Brieger saw with his own eye, water squirted into the nose come out of a "ancienne et large perforation du tympan" (old, large perforation of the drum), I can say that the same has often been observed in my practice, but never have I deduced from that, that in an entirely different hydrostatic condition, i. e., where the drum is intact, water could be forced into the ear by means of an air-tight pump.

Under the two conditions named, the water, during the syringing of the nose, will rather not and cannot enter the ear. (1) For the tuba Eustachii is not a wide canal, as many believe from anatomic specimens which, be they ever so clever, are after all reconstructed dissected specimens, e. g., Fig. 996 and 997 of the anatomic atlas of Heitzmann-Zuckerkandl[36], but as shown on frozen cadavers and heads sawed through in toto, such as the classic drawings of W. Braune[37] in the Handbuch der Rhinologie und Otologie, partially, also, those of B. Fraenkel[38], Zuckerkandl[39] and Toldt[40], it is a narrow slit into which water can penetrate during syringing of the nose only after the air is removed from the middle ear. A similar condition to this was found lately by Menzel for the frontal sinus, when on injecting water into the antrum, it will enter only when there is a counter-opening in the forehead.[41] (2) Even after introduction of the catheter into the tube in living people, water cannot be forced into a healthy ear by means of an air-tight pump (Zeim[42]). (3) Even during swallowing the drops of fluid found in the ostium tubæ do not enter an ear whose drum is non-perforated (A. Lucae[43], J. Gruber[44] and Nicaladoni). (4) Just as little does it take place when the patient swallows while the nose is being syringed, as I stated before and as I have lately demonstrated on a number of persons. (5) Even when the nasopharynx is syringed with a curved tube and an air-tight pump, water does not enter the middle ear when the drum is intact, as Schwartze and Lennox-Browne[45] have noticed.

Also, as I desire to add, not when the patient swallows during this procedure, which many can do.

It could be theoretically supposed—of course, I have not tested it experimentally—that during syringing of the nose anteriorly or posteriorly, water would enter the ear during a false swallow with subsequent cough and insufficient closure of the nasopharynx by a slowly functionating or paretic velum, or if the external nares were held closed at the time, causing the soft palate to sink; the greatest care must be taken to prevent false swallows and cough during the lavage. Although it would be possible to cause drowning by forcible, careless pumping of water into the nose of a man who was forcibly held, no one would for this reason discard lavage of the nose for therapeutic purposes.

That, after lavage of nose, fluid can be forced into the ear by blowing through the nose, and almost all cases of entrance of fluid are to be explained in that way, has been clearly shown by Guye.[46] Just as self-evident is the refraining from cold injection fluids as well as going out into the fresh air or standing at an open window before ten to fifteen minutes have passed, otherwise colds and headaches are easily acquired.

After all has been said, I still believe, in spite of the remonstrances, rising even to personal attacks, of M. Bresgen[47], that lavage of the nose with a physiologic salt solution and an air-tight pump is a very good healing agent, especially in "scrofular" diseases of the eye and nose.

Children can almost always be persuaded to bend forward, open their mouths and let the treatment be carried out. Very small children are held horizontally over a bucket or the like and are lavaged, having care that they do not swallow and get water into the ear, the larynx or the trachea. If they cry forcibly, it is so much the better, since the closure of the nasopharynx is so much the firmer.

There are straight, delicate or thick tubes, with perforations in the sides, for introduction deep into the nose and lavage of its upper part, and nasopharyngeal tubes which, in contrast to Courtade[48], I would not discard, since after lavage of the nose anteriorly a subsequent lavage of the nasopharynx frequently removes a very large amount of pus. That use of water causes headache was known long before Bresgen.

Tavel's salt-soda solution is not pleasant nor are injections of milk or camomile tea, while in use of carbolic acid, alum or zinc, lasting disturbance in the olfactory power have been observed (cf. Lichtwitz l. c.). Borax and broic acid finally attack the heart. Doubtful water is to be boiled.

This lavage with salt water acts, contrary to the belief of some, not only by purification but also, as might have been deduced from the salty condition of the ocean, by attacking the pus and filth, and by furthering the lymphatic and venous circulation in the neighboring organ, apparently to a considerable extent, as can be seen from the following facts: the clearing up of the forehead which frequently takes place at once, the increase in vision claimed by the patient but not objectively demonstrable, the easier nasal breathing, and as so often seen by me in angina, easier swallowing, the increase of saliva which often follows, but whose genesis is not yet explained, etc. Furthermore, many children at once open the lids, which had been convulsively pressed together, after lavage of the nose, even without it being necessary to follow the advice of Jüngken, A. v. Gräfe and Schmidt-Rimpler, viz., to plunge the head suddenly into a vessel of cold water, a rough, not uninjurious method and one certainly hard to repeat on the same child. In many patients who originally consulted me for nose or ear and not eye trouble, I have often seen a distinct and permanent paling of a conjunctiva, formerly chronically reddened, after simple lavage of the nose without any local treatment. Some patients with acute ocular catarrh were treated *experimenti causa,* also, only by lavage of the nose with salt water, frequently resulting in a quick disappearance of the ocular catarrh. Furthermore, there are numerous patients treated elsewhere, only with local treatment for the eyes, whom I have cured by combined treatment of the eyes and nose; e. g., in 1902, a 6-year-old girl, who had been treated elsewhere for six months without the slightest benefit, was cured in a few days and has remained well since; in January, 1903, a young laborer who had suffered from agglutination of the lids in the morning, in spite of a five weeks' "clinical" treatment; in 1893, a 17-year-old girl, who, for three years had been treated clinically for recurring, "scrofular" keratitis, and who had had an iridectomy performed for opacity of the cornea, but who had been discharged uncured. She was my assistant for a long time but later on married, and has remained healthy to this day. On the 16th of this December, there came under my treatment a 17-year-old girl who, from April to June, 1905, eight weeks, had been "clinically" treated with atropin and yellow ointment, likewise from October 21, 1905, to January 27, 1906, fourteen weeks, and again last June for nine weeks with cocain and yellow salve, by another oculist—on September 16, the vision of left eye =4/60, there were numerous fresh infiltrations and old scars of the cornea and purulent catarrh of the nose, which had never been treated; lavage of eyes and nose, cataplasm, gauze-cotton dressing, raspberry wine (cf. later). The result on the 22nd was already 4/18, and on 29th she was able to work.

The results which I obtained in the method described of treating the nose in diseases of the eye do not seem to be accomplished by other means, or at least uncommonly, especially by the method, lately recommended, of occasionally wiping out of the nose with cotton sponges or a brush moistened with a sublimate solution. Nor does the method of blowing in powders, which stop up the nose at once, or menthol, which does it later on, which in the following case, seen by me, acted in an almost incredibly injurious manner: F., pupil, in spite of absence of any subjective complaint as to his eyes, was constrained by an oculist to submit to be treated for infectious ocular catarrh by cauterizations. Then, on account of getting steadily worse, was treated with insufflation of powder into the nose by the rhinologist N. N. The condition grew still worse, and finally an operation was performed on one eye (iridectomy) by the oculists N. and N. N. N., resulting in phthisis bulbi. Some years later accidentally seeing the patient, a glazier's assistant, I syringed out his nose a couple of times, whereupon he stated that his head and ocular stump felt better than for years. The eyes are not helped by tamponing the antrum with iodoform gauze (Fehr, Hirschberg and Adler[49]) and the like, something which I have never done nor recommended since, instead of a broadening of a contracted field of vision, one would rather expect a further contraction on account of intoxication. Nor does the blowing of air into the nose help (Courtade, Vohsen).

Ocular conditions, furthermore, are not aided by galvanocautery of the swollen mucous membrane of the nose, which I have not used for fifteen years, and which in most diseases of the eyes acts much more injuriously than beneficially[50], all of which I can prove, and ask that my remarks be tested.

In regard to the communications of Prof. Schmidt-Rimpler in Halle on the importance of nasal diseases in ophthalmology, that of 225 trachoma cases in his clinic, 128 were not found by the late Prof. Grunert to have any pathologic condition in the nose, it must be noted, 1st, that it does not appear whether the test lavage of the nasal cavity, so often stated by me to be indispensable, was made or not. 2nd, that Prof. Schmidt-Rimpler unfortunately seems to have forgotten my articles on the frequent occurrence of trachoma with nasal diseases, which has been confirmed by Prof. Fuchs of Vienna, Prof. Kuhnt of Königsberg, Prof. Galezowski of Paris and Schmidt-Rimpler's own pupil, Prof. Hoppe of Elberfeldt[52], who found an "astonishing" number of cases of "foul ozena" complicating trachoma, in East Prussia, whereas the further demonstration of this relationship is of the greatest importance in the study of "scrofular" ophthalmia.

Here, also, belongs careful attention to primary disease of the teeth, which is a very frequent, though often unrecognized cause of nasal trouble, as recently seen in a woman treated for two years in W.; i. e., caries of the teeth, periostitis, abscess of the root, filling of the teeth and remnants of teeth; also, the test lavage of the antrum through the alveolar process, and of the frontal sinus from without, with proper treatment of the affected sinus, as often as possible without the resection of the walls made by many entirely unnecessarily and as a sort of a routine. Many patients who have unfavorable dwelling conditions such as on the Herz mountain near Zittau, have been cured by resection of the walls or floors of their dwellings. Also, the removal of deflections of the septum, nasal polypi and adenoid vegetations, so often the cause of the eyes remaining open during sleep, provided there is no fever and the lavage of the occasionally suppurating nose[53], combined with the internal administration of weak iodin preparations, recommended by French authors, are ineffectual. Furthermore, the removal of palatal tonsils, which, however, is not always necessary, following which I have seen, as in several cases described in 1886, a distinct improvement[54] and even cure of a "scrofular" eye that had been treated for relapses for seven years, without results. Then, too, the cure of the cleft palate, causing nasal trouble (Alt, Toronto[55]), etc. Furthermore, in spite of the opposing views of many as an "unnecessary" bother, the us of good (English) leeches behind the ear in the regio retrolobularis for the purpose of depletion, since only there can the lymph vessels of the back part of the nose and of the orbit and bulb be attacked (Ziem[56]). Care in preventing cutting and washing of the hair during the existence of an eye disease, or shortly thereafter, for an accentuated nasal catarrh often causes an increase in the disease or a new attack of an almost healed ocular disease; likewise entering unheated churches, the use of cold footbaths in cases of habitual cold feet, and finally in spite of the contrary advice of John Locke, the avoidance of damp shoes, etc., and the wearing of rubber shoes when sitting for a long time in school, etc.

C. Scrofular diseases of the eye are often accompanied by symptoms of fever, a fundamental condition which heretofore has been overlooked by everyone, including myself. I have not taken the temperature of my almost exclusively ambulatory practice, still one often finds on asking, or even subjectively, that towards evening, chill, cold shivers or transitory heat or sweat appear, and children become restless or irritable. Headache, dizziness, bad dreams and restless sleep, loss of appetite, coated tongue and bad taste, eruptions on the skin, foul smelling stools and often considerable thirst are present. The treatment of the fever is very important, and usually requires the mildest remedies; castor oil or tamarind, fresh or cooked fruit, flores sambuci or tilac, warm milk or warm, acid lemonade to cause perspiration, juices of lemon, raspberry, cherries, gooseberries, apples, plums, etc., with some sugar and not too cold water to be drunk frequently, I repeat frequently, during the day, abstinence from coffee, of whose injurious qualities I have frequently convinced myself, e. g., in a case of ulcer of the cornea recently treated by me, where in spite of my insistent and repeated forbidding of coffee, the 17-year-old girl secretly drank it, whereupon and only on account of the fever being kept up by the coffee, there followed a perforation of the cornea with prolapse of the iris. This is a circumstance which in spite of the contrary belief of Prof. Schmidt-Rimpler (l. c. p. 432), is not very frequent, at least in my experience. Its existence in the Egyptian eye diseases is perhaps to be referred to the frequent drinking of coffee. Furthermore, it is necessary to abstain from tobacco and tobacco smoke in a room, from all alcoholic drinks. Through these simple means, which frequently may be used in association and charity practice (cf. succ. citri and syr. rub., idaei of the pharmocop. oeconom. Berol.), in conjunction with the above described treatment, frequently rapid amelioration or healing takes place, even of the crusting eczema of the face and head.

The stubbornness of "scrofular" diseases of the eye may frequently be due to the drinking of unhealthy febrile water, especially that of the Nile in lower Egypt (Alexandria), which, on addition of potassium permanganate, always, in 1880-1882, gave me a rich precipitate of organic matter. It is used in the preparation of coffee and the soda water and lemonade sold on the street, as well as the fruit ices, always used there unsterilized. Yet, in the eye diseases in Egypt, which, of course, also attack children, the effluvia, already observed by Lane[58], from the overflowed land, is of great importance, especially since, according to my observations, the ocular diseases there are often associated with purulent nasal catarrh. Finally, among the influences bad for the eye, is the dust from unpaved streets, as well as the piles of dust in the streets, which are used for heating baths. The high temperature of the air does not cause the diseases of the eye, since other countries in about the same latitude, such as Mesopotamia, Babylon, Libya, Malta, etc., were never rich in eye diseases. In contrast to Egypt, filled even at the time of Herodotus with physicians and oculists, in Babylon which was protected from overflow by the wonderful walls of Nitokins, there was at the time of Cyrus, not an oculist and not even a professional physician. The nomadic Libyans were the healthiest men whom Herodotus ever met (I, 185, 197; II, 84; IV, 187), and according to a description of travels cited by John Locke, the Maltese children ran naked until 10 years of age, or "went without shirt, drawers or anything on their heads sheltering them from the scorching rays of the sun."

Sleeping near an open window, which often gives such good results in chronic nose and throat troubles, I have tried only in a few cases of scrofulous diseases of the eye, yielding too much to a popular belief. I employed it very recently with distinct success in a case of a 17-year-old girl with purulent conjunctivitis, rhinitis and blepharadenitis, whom I had treated for several weeks without result. By means of hours spent in forests, especially pine forests, or when it was a laborer who could not take a vacation, by means of evening and Sunday walks, I have cured stubborn catarrh which were not affected in any other way. For example, there is the case of a printer's apprentice who worked in a damp dusty room, and who shared a medium sized room with 10 other persons, of whom one was a sister suffering from purulent, foul-smelling fistula of the breast which had been operated several times without benefit. That in unhealthy dwellings only one child has eye trouble, is explained very simply on the ground of an unequal resistance of the children, perhaps due to a predisposition to diseases of the nose frequently observed by me. Change of residence must be insisted on if the living room is separated from a stall (pig-stye) only by a thin, pervious board-partition, which I saw in 1897 here in Danzig. H. Schmiegesell, July, 1897, hypopyon keratitis, purulent rhinitis. Vision=1/60; residence changed at once, ambulatory treatment with lavage; able to work July 16, '97, with vision=5/12. S., successor of latter, July 12, 1897, acute purulent rhinitis and conjunctivitis; residence changed at once, lavage, cure in a few days. Similar cases have been reported from East Prussia by J. Jacobson and Hoppe, from Ireland by Maria Edgeworth, from several places in France by Aimé Martin, from Hungary by Fener, also from Russia and Poland, where the unboarded floors of the clay cottages in the villages even today are freshened with soil containing cow dung.

The question of dwelling, so very important for the study of tuberculosis (scrofulosis), can of course not be discussed here any further; for example, the houses of St. Petersburg built on a swampy foundation and overflowed frequently by floods from the Baltic Sea which yield annually thousands of eye cases; the streets of the present Jerusalem which are filled with rubbish, dogs and foul vapors, in which "ein müdes Leben schleppend seinen gang geht," and where every third man is blind in one or both eyes[59], many sanatoria which are built not like that in Lowschwitz near Dresden on a platform, but on a slope where in spite of their "sun rooms," their back rooms are damp at the time of melting snow or downfall of rain; the huts on the Riesengebirge, where the floors are damp in summer and the hut buried in snow in the winter; the sloping houses of a city so rich in nose diseases and trachoma as Trieste; the narrow-fronted, poorly ventilated houses of Danzig in comparison to the houses of Alexandria with their wide central courts, or the squares of London. Let us hope that the time is not far off when shutting up an eye patient in a closed room, or an overfilled, darkened and as little ventilated as possible "Clinic" will not be demanded, as the first step towards cure, when 97 to 98 per cent will be treated ambulatory, with light and air—a sea of fresh air—and when in the opinion of Brémontier, Oberlin, Aimé Martin, pastor Mattheus of Onstmettingen in Würtemberg and others, science will develop its whole force for the relief and cure of even "scrofular" diseases of the eye.

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3. Cf. Ziem, Allgem. med. Centralzeitg., 1886, Nos. 68, 69; 1897, Nos. 30, 31.

4. Beziehung zwischen den Krankheiten der Nase und denen des Auges, Arch. f. Laryngol. 15 Bd.

5. Klin. Monatsbl. f. Augenh., 1895, July; Jour. of Laryn., 1895; Nos. 10, 12, and Transact. of the British Laryng. Assoc., 1895, Appendix, p. 15.

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XC.

NASAL OPERATIONS.*

By J. Baratoux, M. D.,

PARIS.

During the discussion before the German Otologic Society, in May, 1903, and the London Laryngologic Society, in November of the same year, upon the subject of nasal operation, chiefly from the viewpoint of anesthesia and post-operative care, I was struck with the difference of opinion, for I had, for my part, adopted a method which up to the present has given me excellent results.

To begin with, in every nasal operation I reject general anesthesia, whether for a deviation of the septum, a spur or hypertrophy of the turbinates. I have only had recourse to it on one occasion, in a young South American woman who had a septal spur which I wished to remove with the electric saw. As this patient absolutely demanded that she be given chloroform for the operation, I was obliged to administer this anesthetic agent. I should add that having operated upon the nose of her sister under local anesthesia, my patient did not hesitate subsequently to let me use the same procedure for a partial tubinectomy which I did two years later. She voluntarily stated that she felt no pain, and preferred this method to the former, which made her sick for two days.

My procedure is as follows: Two days before and the day before operation, I give insufflations of boric acid and avoid all injections. Ten minutes before operaton I mop the nasal fossae with cotton upon an applicator dipped in the following solution:

Cocain hydrochlor	1
Adrenalin sol. 1 to 1000.......	5
Sterile water	5

Generally I content myself with a single mopping, but if the nostril is too narrow from swelling of the mucosa, I use a preliminary spray of this solution diluted with sterile water.

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*Translated by Albert Miller, A. B., M. D.

In passing, I recommend to my confreres who use a large number of these aplicators, a proceeding which I have employed for several years, to cover them with cotton. By means of a spinning-wheel which I have so modified as to be able to introduce the point of the applicator, I can obtain in one hour 40 applicators regularly covered with cotton. These are then placed in flasks and sterilized.

Five minutes after the first nasal mopping, I do a second with the following mixture:

Carbolic acid crystals..........	1
Powdered menthol	1

Triturate to liquidation and add

Cocain hydrochlorate..........	1

At the end of about five minutes the anesthesia is manifested by a peculiar sensation in the upper incisor teeth. The patient loses sensation in these teeth. This anesthesia is sufficient for an operation of half an hour or longer.

I have sometimes had recourse to submucous anesthesia with cocain solution or Schleich's solution. I will say that I have never obtained so good an effect with these as with the method which I recommend.

There is now to be considered whether or not a dressing should be put in after operation.

Where operators have expressed such divergent opinions upon this point, it is because fear of infection has determined them to use no dressing or not to leave it in the nasal fossae more than two days; and then it is very difficult to remove it without producing hemorrhage. I believe I have solved this question by the use of gauze strips with salicylic acid. Salicylic acid possesses well-known analgesic and antifermentative properties.

These strips, 0.20 m. in length by 0.02 m. broad, are dipped in a 10 per cent solution of salicylic acid. In certain cases I use wider strips, 0.05; when the nasal fossa is very large, for example.

When the operation is finished, I insufflate powdered aristol to arrest all flow of blood; then I introduce a strip to the furthest extremity with my forceps, which are concavo-convex. I place it so that this strip is well applied to the posterior part of the turbinate, if it is a turbinectomy, for it is often from this portion of the turbinate that subsequent hemorrhages come. (In passing, I want to say that I am not an advocate of total turbinectomy.) This first strip should be well packed in the posterior nasal fossa, and so that it will not fall into the pharynx. This accident is easy to avoid if the depth of the fossa is observed beforehand.

This piece of dressing being placed, I introduce two or three more, packing them little by little. If the fossa is not sufficiently filled up, another strip may be applied above the others. Finally, close the naris with a bit of cotton, which may be replaced in twenty-four hours with cotton moistened with hydrogen dioxid.

If during the application there comes on a sanguinolent exudation, it may be easily stopped by putting powdered aristol between the layers of gauze.

I have never seen a serious hemorrhage follow this dressing, consequently it is hard for me to say whether or not adrenalin favors secondary hemorrhage.

Several years ago, when adrenalin was unknown, I used some extract of suprarenals. With this agent I had two marked hemorrhages. The first case was that of a young girl in whom I removed a small spur with the electric saw after mopping the mucosa with extract of suprarenals. This patient concealed from me the fact that she had had several serious hemorrhages from the extraction of teeth. Neither hydrogen dioxid, nor antipyrin nor ferripyin, nor gelatinized serum, nor tamponing would arrest the hemorrhage, which finally stopped upon giving ergotin subcutaneously.

The second case was one of narrowing of the nose from traumatism. A hemorrhage coming on in the course of operation, I tried to stop it with tampons dipped in extract of suprarenals. Immediately the blood flowed in greater abundance. I had to resort to tamponing. I repeat that I have never seen such an accident with adrenalin.

After the operation, the patient remains under observation in my office for about an hour. During the first day the patient keeps to his room. Every three or four hours he renews the cotton in the vestibule, after dipping it in hydrogen dioxid.

The next day the patient comes to me again and I take out the cotton and sometimes even a part of the gauze, after spraying with or injecting hydrogen peroxid. For that matter, it is advantageous to use the injection in order to remove the gauze, especially in operations upon the septum, as in submucous resections. If there is a flow of blood I put in a bit of gauze after insufflating with aristol. During the day the patient moistens the dressing with hydrogen dioxid.

Generally I take four days to remove the dressing entirely. Frequently I do not get it all removed until the eighth day. It is then blackened, but has no odor and does not inconvenience the patient. By this procedure I have never seen any infection such as arises with ordinary packing even when left in the nose only a short time.

In closing, I wish to remark that patients sometimes complain of a tickling in the nose which will provoke sneezing unless the root of the nose is firmly grasped by the finger. It is not the first dressing after operation which produces this disagreeable sensation, but only when it is necessary to replace one of the gauze strips.

XCI.

PSEUDO-FRONTAL SINUSITIS; SUB-PERIOSTEAL ABSCESS OF THE FOREHEAD COMPLICATED BY THROMBO-PHLEBITIS OF THE SUPEPERIOR LONGITUDINAL SINUS EXTENDING TO THE LATERAL SINUS AND JUGULAR VEIN ON THE OPPOSITE SIDE; MENINGITIS; DEATH; NECROPSY.*

By Dr. V. Delsaux,

EDITOR OF LA PRESSE OTO-LARYNGOLOGIQUE BELGE,

BRUSSELS.

Through the kindness of the President, I have been invited not only to attend the present meeting but also to read a paper on a subject which I hope will be of some interest.

Two months ago there came under my observation at St. John's Hospital a woman, aged 20 years, who complained of severe headache, sleeplessness, fever and prostration of two days' duration. Before that time, she had been quite healthy and had never suffered from any disease of the nose or accessory cavities. She was married and had two healthy children.

Examination of the patient showed the following:

Pharynx, somewhat inflamed, mucous membrane relaxed and covered with pus. Nasopharynx, covered with muco-pus. Nose, partially obstructed on the left side by deflection and spur of the septum. The right nasal cavity was quite free but somewhat purulent in its inferior part, while the middle turbinate and the septum were found to be in contact.

After the use of cocain and adrenalin for a few minutes, the mucous membrane of the middle turbinate became less swollen but the pain continued as severe as before.

On transillumination both frontal maxillary sinus were found translucent. No exploratory puncture was performed.

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*Read at the meeting of the British Medical Association, Toronto, August, 1906.

Ears. Nothing of importance was discoverable; the patient did not complain of pain or tinnitus.

Before recommending any surgical intervention, I advised the patient to snuff boro-menthol-cocain ointment into the nose every half hour, to take an aperient and to have a warm foot-bath in the evening.

On the following day the condition remained about the same so I advised the paient to enter the hospital; this she refused to do.

In view of the possibility of purulent retention in the ethmoid cells, the anterior part of the middle turbinate was resected and after light plugging with stypticin gauze, the patient was allowed to go home.

Two days later, the patient came to the hospital. I found her complaining of more and more pain in the right side of the forehead above the eyebrow. Pressure on this place caused severe pain. There was swelling of the skin but no fluctuation. The temperature was 102.5° in the morning, rising to 104° in the evening.

Lumbar puncture was immediately performed and examination of the eye fundi made. On the day after, I found the patient's condition much worse; the swelling of the forehead had greatly increased and fluctuation was present.

The observations on the lumbar puncture were as follows: Pressure of liquid much increased; lymphocytes 35 per cent, polynuclear 16 per cent; some blood corpuscles present.

Examination of the fundi showed congestion and subpapillitis on the left side (while the pain was felt on the right side).

I then opened the subperiosteal abscess, evacuating a teaspoonful of pus and explored the right frontal sinus which was found to be quite normal. There were no congestion or swelling of the mucous membrane and no pus.

I put a drain in the sinus opening and another under the periosteum and applied a dressing. In the evening there was no improvement; the temperature was 104.5°. When I saw the patient on the following day the fever was still 103.3°, the prostration had increased and there was a swelling behind the left ear. Pressure over the mastoid was very painful, while examination of the ear showed drum free from all swelling and Schrapnell's membrane red but not bulging.

Below the mastoid there was an extensive edematous area but no pus was found upon puncturing twice.

The prostration increased very considerably in the evening of this day and death occurred on the following night without convulsions, rigors or paralysis.

I was fortunate enough to secure an autopsy, with the following results :

On opening the skull, great difficulty was experienced in separating the meninges from the bone on the right side. When they were divided in the median line, an intradural layer of pus was found over the surface of the anterior part of the right frontal lobe.

The longitudinal sinus was thrombosed, while the left lateral sinus was also found thrombosed but it had undergone purulent disintegration as far as the jugular bulb.

Further on, lower down in the neck, the vein was thrombosed but there was no pus.

Both frontal sinuses, ethmoid cells, sphenoidal and maxillary sinuses were explored without the least trace of inflammation being discovered. Nothing abnormal was found in the left ear.

There was nothing of importance in the heart cavities. The uterus, which was examined for obvious reasons, was quite healthy, as were the kidneys and other organs.

The following is, it seems to me, a plausible explanation of this case :

For some unknown reason a subperiosteal abscess formed above the right eyebrow, rendering the diagnosis uncertain during the first three or four days.

The resection of the anterior part of the middle turbinate had nothing to do with the fatal result.

While microscopic examination does not enable us to prove any association between the external purulent focus and the obliteration of the superior longitudinal sinus, it is quite probable that a microscopic examination would have shown a purulent thrombosis of one of the communicating bone veins, the so-called emissary veins.

As to the extension of the thrombosis to the left lateral sinus, it is to be supposed that there was a wide and direct continuity between these two blood vessels.

If we ask what indications the lumbar puncture could give us, it is to be noted there was a positive and undoubted change in the lumbar fluid.

At the same time examination of the fundus of the eyes revealed a distinct difference between the two optic papillae—the greater alterations being found on the same side as the lateral sinus thrombosis.

On the other hand, the fever was quite continuous, not at all remittent, as commonly happens in cases of jugular thrombosis.

Finally, it is to be considered that no paralysis being present, there were no focal localizing symptoms, consequently no indications for operating on the skull. Thus my conclusions are:

1. A genuine thrombosis of the longitudinal sinus may occur without any extension of a septic infection from the nose.

2. Epistaxis may be entirely absent as a principal sign of the thrombosis.

3. The anatomic reason for the more frequent extension of the thrombosis of the superior longitudinal sinus is the broad and direct communication between these two blood vessels, found in the majority of instances, while the straight opens rather directly into the right lateral sinus.

4. A preliminary exploration of the frontal sinus is to be performed for the same purpose as exploratory laparotomy in abdominal cases.

XCII.

INTERCRICO-THYROID TRACHEOTOMY AND DECANULATION.*

BY PROF. E. J. MOURE,

EDITOR OF REVUE HEBDOMADAIRE DE LARYNGOLOGIE, D'OTOLOGIE ET DE RHINOLOGIE,

BOURDEAUX.

Several years ago (August, 1900), I addressed the Paris Academy of Medicine upon the difficulty of decanulating infants and children whose air passages had been opened in the intercrico-thyroid space and the canula left in place several weeks or months.

Since that time I have had occasion to observe numerous cases which corroborate the opinion I then expressed as to the causes of these laryngeal stenoses.

If we consider the very small space presented by the intercrico-thyroid region in the infant and child, we easily recognize that it is impossible to place a canula here without cutting the cricoid. Further, I have seen practitioners impelled by the grave asphyxia of their patients, open the thyroid as well as the intercrico-thyroid space, and consequently place the canula partly within the larynx.

In these cases the foreign body is situated immediately in the subglottic region, in the neighborhood of the vocal cords. As a result there is chronic swelling of the irritated part and an infiltration which of itself is almost sufficient to prevent the passage of air by way of the larynx. There is actually a chronic edema in a region which cannot dilate and this as a result produces considerable stenosis.

If we reflect further, that to instal the tracheal canula it is necessary to spread open the two plates of the cricoid, we readily understand the effect upon the crico-arytenoid articulations which would ensue upon opening such an important cartilage, and one which sustains the articulations active in breathing.

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*Communication to the Surgical Congress, October, 1906. Translated by Albert Miller, A. B., M. D.

The almost complete immobilization of the arytenoids behind, by spreading the cricoid ring and the subglottic infiltration previously mentioned are two factors which combine to produce a laryngeal stenosis, temporary at first, then permanent, or in any event a very grave one, if children are not quickly decanulated before there is rigidity or ankylosis of the articulations which then no longer functionate, so to speak.

This also explains the socalled spasms of the larynx which attend some decanulations in patients having flexible cartilages, tracheotomized in the intercrico-thyroid region.

I have very often seen this phenomenon even in adults, in conditions above mentioned. It is the rule in children, so to speak.

The therapeutic conclusions from this way of looking at it are readily deduced.

If for any reason whatever an intercrico-thyroid tracheotomy has been done upon an infant or child, the canula must be removed as soon as possible to avoid the glottic and subglottic laryngeal stenosis which follows the prolonged stay of a foreign body.

In cases where laryngeal stenosis has already supervened, the patients are not to be treated at all by dilatation, for such intemperate maneuvers only irritate the inflamed region. They also have the grave inconvenience of producing cicatricial synechiæ which are now serious, for these permanently obstruct the larynx by creating an incurable tubular narrowing, thus condemning the patient to wear a canula always thereafter.

As Schmiegelow said several years ago, and as I myself advised about the same time, the first duty of the surgeon should be to place the canula in the trachea below the point where it had been, taking care to leave a ring of healthy tissue between the two incisions, to avoid the tube slipping up into its former situation.

This done and the respiration being assured, we wait patiently for time to do its work, for the infiltration to be slowly absorbed, and for the arytenoids to resume their function, if not normally at least sufficiently to assure the free entry of air into the uper passages.

At this period, after being sure of permeability of the larynx by direct examination, we may decanulate the child, but not without first habituating it for some weeks or months to natural breathing by closing the canula.

I will not multiply the observations which support this view. I will content myself with saying that every time I have seen infantile laryngeal stenosis it was produced by a tracheotomy too high up and in the course of which the cricoid had been divided.

In the cases which I have had to treat I have done more by patience and displacement of the tube than by the dilatation which these young subjects had undergone, a dilatation which was usually ineffective and sometimes even harmful by reason of the ulcerations and cicatricial synechiæ which it occasioned.

To sum up: Intercrico-thyroid tracheotomy constitutes in general a bad operation for patients with flexible cartilages.

It should be reserved for urgent cases, in which it is certain that the canula will not be left in too long, or for adults with dilator paralysis or even aneurysm, in whom it is a matter of putting in a permanent canula which will never be taken out, such as we unforunately meet with in practice, in tabetics or others attacked with bilateral paralysis of the vocal cords.

The intercrico-thyroid is a tempting operation for it is easier to perform than a true tracheotomy, but it must be admitted that the latter is not very difficult in infants or children, and that in adults there is usually time to intervene before asphyxia sets in.

An important point, to avoid cutting the cricoid, is to take the latter as a landmark and as the upper limit of the cutaneous incision.

XCIII.

NOVEL METHOD OF TREATMENT OF SYNECHIA OF THE PHARYNX.

By Edward J. Bernstein, M. D.,

KALAMAZOO, MICH.

The treatment of cases of more or less total synechia of the pharynx has always been of great concern since attention was first directed to it. Most men give up in despair and those cases which are fought out to a successful issue must each be taken as a law unto itself.

Nearly every rhinologist has tried some new trick and nearly all accord more failures than successes.

In the mechanical treatment of this case I believe I have something novel to offer, inasmuch as I have seen no reference to such and no one to whom I have written seems to have attempted it.

The case is as follows: Bert F. was sent me by Dr. John B. Jackson with this history: at the age of 9 (3 years ago), he was taken with an attack of diphtheria in which the whole soft palate and pharynx became involved in an ulcerative process. There was also ulceration present in larynx. As a result of this, the anterior and posterior pillars of the fauces, together with the soft palate were glued into one solid mass to the posterior wall of the pharynx, except for a minute point in the median line, through which I could pass a very fine sound.

In the larynx, nothing normal remained but the epiglottis and the anterior two-thirds of the left vocal cord; the rest was taken up by huge masses of new growth. It was marvelous how the little fellow managed to breathe at all through so small an opening. His voice was entirely gone. As a result of his total synechia in the pharynx and a subsequent attack of la grippe, and the blocking up of the nasal secretions, there appeared an otitis media suppurativa chronica with necrosis of the mastoid and polyps in the middle ear, all of which I demonstrated to several colleagues.

Cultures taken from the ear showed staphylococci albi and aurei, but no streptococci nor other organisms.

He came to me a pale, cadaveric looking, undersized boy of twelve, with constant dyspnea—mouth always open and with a most offensive smelling ear.

After reviewing my own lack of successes, and looking over the devices suggested by other operators to overcome the synechia, I decided to try the expedient suggested to me by Dr. Fletcher Ingalls, that of attempting to pass a thread through the scar tissue between the mouth and the nasopharynx. This I found to be unfeasible, owing to the ivory like denseness of the scars and to the further fact that, when I did finally succeed in passing one thread through and tying it in a loose knot, instead of slowly working its way through and the opening becoming epidermicized, as is the scope of this procedure, the resisting power of this structure was so poor that it tore through in a few days and the opening healed up almost as fast as it formed.

I then decided to punch out a lage mass from one side with the punch-forceps used for tonsillectomy. I obtained a large hole thus and in attempting to repeat the procedure on the other side, a few days later (under ether anesthesia) the boy suddenly became cyanosed and stopped breathing, owing no doubt to the irritating influence of the ether down his already nearly occluded windpipe, and a rapid tracheotomy was necessary. I had fortunately provided myself with a tracheotomy tube. We were thus able to restore the boy, who appeared to be dead. In a few weeks we were again able to operate on him and this time a very large opening was made from the mouth to the nasopharynx.

The problem of how to prevent closure presented itself. After much experimenting, I finally determined to have the dentist make a plate which would fasten on his last molar teeth on the side and his incisor teeth in front, which plate, fitting like that for a set of artificial teeth, should carry on its posterior border an inverted "U" shaped plate—very similar to the blade of the Gottstein curette—whose function it was to keep open this aperture. We found this shape best, as it left the soft palate free and thus did away with the irritation of a foreign body on this structure. The boy wore this, after a very short trial, with perfect comfort and it did the work admirably. I am indebted for the execution of this device to the ingenuity of my dentist friend, Dr. A. Chisolm of this city.

As a result of our ether anesthesia, he sustained a severe tracheitis: it was while waiting for this to subside sufficiently to enable us to do a radical mastoid operation, as the next step in the series of operations that we had planned, that his tracheotomy tube became suddenly clogged up and before help could be summoned, he choked to death.

At the post-mortem, no evidence of tuberculosis could be found, though every organ was subjected to microscopic investigation. Aside from the condition of the larynx, which was a pathologic curiosity, nothing but a few broken down mediastinal glands were found; no giant cells or tubercles could be made out.

Through the thorax I was able to take out the entire larynx, and through a linear incision away behind the hair line, I was enabled to get out the entire temporal bone.

A full pathologic report of the larynx and mastoid will follow as soon as I can decalcify the temporal bone and cut it. This part will be quite interesting, as it contains a large aural polyp in situ, as it is rather rare to obtain a specimen in which such were demonstrable in vivo.

XCIV.

A NEW SELF-RETAINING NASAL SPECULUM.

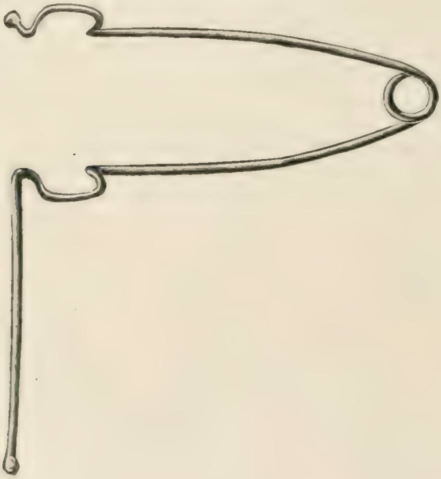
By John H. Allen, M. D.,

PORTLAND, ME.

The self-retaining nasal speculum illustrated herein, was devised by the writer about two years ago, to facilitate the performance of submucous resection operations upon the nasal septum, and has been found so useful in the hands of the writer and others, that notwithstanding the long list of similar instruments already to be had, he feels justified in calling to it the attention of those interested in nasal surgery.

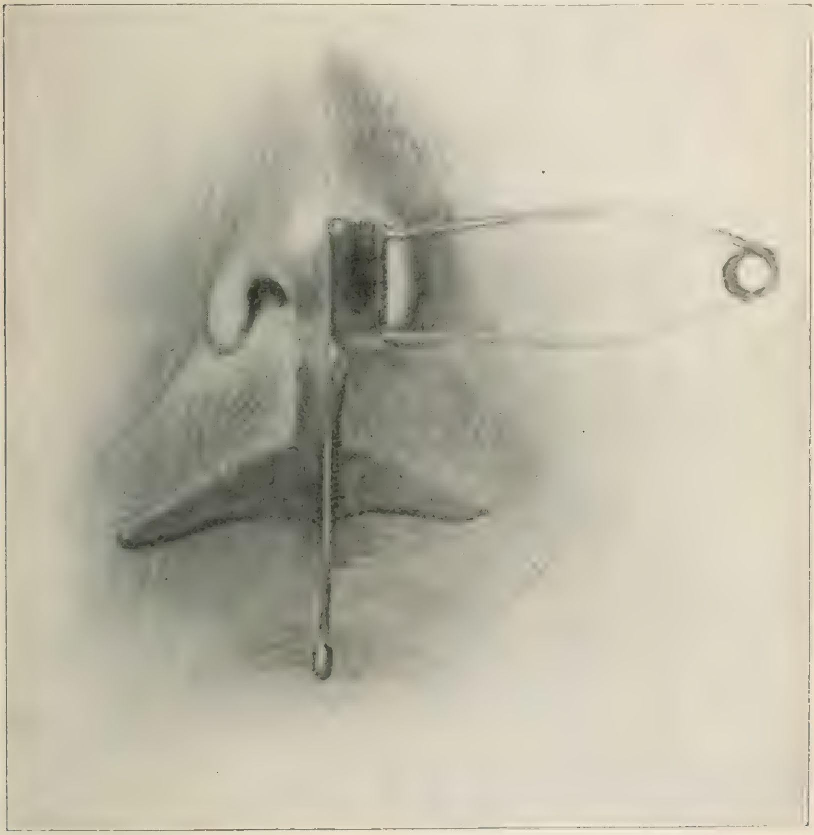
The resection, or so-called "window operation" calls for a greater delicacy of technic than any intranasal procedure has heretofore demanded. Done by the aid of cocain and adrenalin with a practically bloodless field, every step is accompanied by careful scrutiny and should be accomplished with precision, and for this reason it is important that the most favorable conditions for illumination should be obtained. As good illumination is indispensable, and as it is highly desirable at certain stages of the operation to have the free use of both hands, a speculum which will distend the anterior nasal opening to the greatest extent compatible with the comfort of the patient and at the same time be self-retaining, becomes a valuable addition to the armamentarium. This is true even when it is possible to obtain the services of a trained assistant, for even the most efficient assistant, while holding the speculum, will at times obstruct the light or interfere with the movements of the operator.

In spite of the fact, however, that the pages of a single instrument catalog picture no fewer than thirty different specula of the self-retaining type, it was found impossible to obtain a speculum capable of distending and holding the anterior nares in such a position as to permit of adequate illumination of the nasal cavity. In order to bring into view the floor of the nasal chamber together with the inferior portion of the septum and the lower turbinates, it is necessary that the tip of the nose shall be thrown upward until the aperture becomes nearly vertical. This is accomplished by the ordinary bivalve speculum, held in the hand, but no self-retaining speculum could be found which would automatically elevate the tip of the nose. On the contrary, such specula either leave the nasal orifice in its normal, nearly horizontal position, or by their weight tend to drag the soft parts still further downward. In this position, even if the tissues of the vestibule are dilated to their extreme limit, it is impossible to see into the nose except by throwing the patient's head far backward, and then the structures in the upper part of the fossa, only, are brought into view.



The present instrument differs radically from other self-retaining specula, already on the market, and which for the most part satisfactorily retain their position and keep the naris open, in that it thus maintains a vertical position of the aperture. This is accomplished, as will be seen from the cut, by means of a long tail or extension downward from the lower blade, which bears upon the lips and by this leverage holds the soft parts in the position most favorable for illumination and inspection.

The instrument is simple in construction, retains its place satisfactorily and without undue discomfort to the patient, and holds the opening in such a position that a full and adequate view of all parts of the septum may be obtained without changing its position. Its tension may be varied to make it fit large or small openings by merely exerting torsion in one direction or the other, upon the spring wire of which it is constructed. The nose-clips or blades, being of wire, are lighter and less ob-



structive than those of solid construction, and while it is true they do not press vibrissae out of the way, as do solid blades, this is not material in operative work, since the vibrissae should be cut away at the outset.

The speculum is made in rights and lefts.

NOTE.—I am indebted to Dr. David Hefferman for a suggestion in regard to the shape of the nose-clips, which improvement is incorporated in the present model.

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